









Rig and Antennas  
Power.

240

OCT. 43  
TO AUG. 44

Retired Telephone MAN.

1

MILITARY SERVICE WAS NAVY SEA DUTY.

Bombing Squadron 10

ABOARD CVG USSENTON PRISON

MARRIED.

7 Children

2 paralyzed, 1 paralyzed, 1 paralyzed, 1 paralyzed, 1 paralyzed, 1 paralyzed, 1 paralyzed.

age 77

~~JOHN~~

FAMILY 1 wife 3 girls 4 Boys



	00.	42
1	00.	43
2	00.	44
3	00.	45

	JAN. 6	46
9	JAN. 6	45
	JAN. 6	44
	JAN. 6	43
		42



WACEY - CROWN POINT, INDIANA HOWARD,

T54505 AMERITROW  
AL 811 AMR  
ANTENNA. GAP TITAN  
VERTICAL.

RETIRED TELEPHONE MAN

MARRIED

7 CHILDREN 8 Grandchildren.  
4 BOYS 3 GIRLS  
Age 74 75

MILITARY SERVICE.  
OCT 1942 TO JAN. 46

SEP. 43 TO SEP. 44. USS BOXER  
USS ENTERPRISE.  
BOMBING SEP 10.

CV-21  
541RS COMPANY  
CHIEF  
RADIOMAN.

2 LEGGED DOG, NAMED RILEY. PARALYZED AGE 12 YRS.  
RILEY DIED 1988 8 yrs Paralyzed.

SCHOOL. PRINCETON, U. N.J.  
TEXAS A&M COLLEGE STATION, TEX.  
U. OF MICHIGAN, ANN ARBOR, MICH  
BALDWIN WALLACE COLLEGE CLEVELAND OH.  
ILL. INST. OF TECHNOLOGY CHICAGO

NAVY ARMORY CHICAGO.

USS BOXER CV 21  
CR.

WARD ISLAND CORPUS CHRISTI, TEX.

TEX. A&M BRYAN, TEX. COLLEGE STATION.

Before CASU 24 SAND POINT  
ENTERPRISE AT BREMERTON WASH. REFI. SEATTLE WASH.  
after CASU 7 WILDWOOD N.J.







## OPERATING INSTRUCTIONS

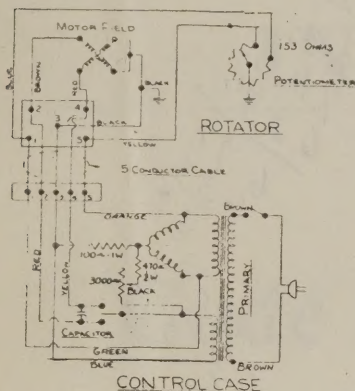
Press down on either end of the bar on top of the control box. Antenna moves as shown by indicator.

## GUARANTEE

The unit is guaranteed for 90 days against defective materials and workmanship in accordance with E.I.A. standards.

## LIGHTNING PROTECTION

For an approved installation of this equipment, it is recommended that the two outside wires of the five conductor cable, which connects between the control box and the antenna rotator on the mast, be grounded through an Underwriters' Laboratories listed approved lightning arrester. The arrester should be located close to the point of entry of the five wire cable into the building.

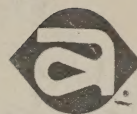


WIRING DIAGRAM

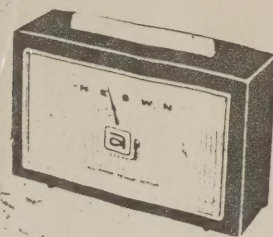


X-9351-B SS Ptd. in U.S.A.

# ALLIANCE TENNA-ROTOR



MODEL T-45



Direction Indicating Model Rotator that gives You These Outstanding Features:

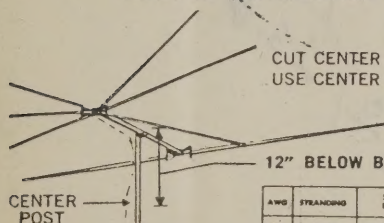
- SUPERB STYLING
- ACCURATE DIRECTION INDICATING
- AUTOMATIC LINE VOLTAGE COMPENSATION
- MOTOR BRAKE
- STEPLESS SILENT OPERATION
- EASY TO INSTALL

PLUS — Position of antenna is shown on dial of control at all times. No switch actuation necessary.

## ROTOR INSTALLATION INSTRUCTIONS

### STEP 1

CUT CENTER POST TO LENGTH. DO NOT USE CENTER POST LARGER THAN 1 3/8" O.D.



AWG	STRANDING	30 FT.	100 FT.	150 FT.	200 FT.	250 FT.	300 FT.	350 FT.	400 FT.
22	7 x 30								
20	7 x 26								
20	DOUBLED 7 x 26								
20	10 x 30								
20	DOUBLED 10 x 30								
18	16 x 30								
18	DOUBLED 16 x 30								

For proper performance do not exceed the maximum lengths per wire size (AWG) on chart.

### STEP 2

SILVER WIRE  
SEPARATE LEADS,  
STRIP AND TIN.

Feed 5 wire cable  
through slots as shown.

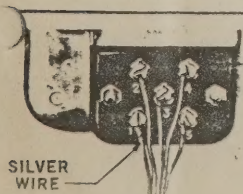


### STEP 3

TWIST WIRES AROUND TERMINAL SCREWS AND TIGHTEN SECURELY.

WARNING: No loose strands of wire to touch adjacent terminals or metal case.

IMPORTANT:  
NOTE EXACT LOCATION OF EACH WIRE



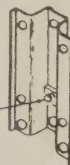
### STEP 4

SLIDE TERMINAL COVER UP CABLE AND FASTEN OVER TERMINALS AS SHOWN.



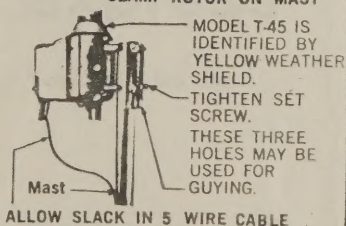
### STEP 5

ATTACH SET SCREW AND NUT TO CLAMP PLATE.

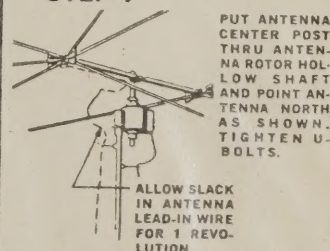


### STEP 6

CLAMP ROTOR ON MAST



### STEP 7



## CONTROL CASE INSTALLATION

### STEP 8

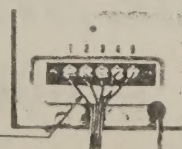
CONNECT WIRES TO LIKE NUMBERED TERMINALS. (See Step 3.)

SILVER WIRE

WARNING: No loose strands of wire to touch adjacent terminals or metal case.

### STEP 9

CONNECT CONTROL CASE TO OUTLET.



### STEP 10

Facing the back of the control case depress the left side of the control bar until Rotator stops turning. The Rotor will now be against the north stop.

CONTINUE DEPRESSING CONTROL BAR. TURN LEAD LENGTH ADJUSTMENT UNTIL POINTER, ON FRONT OF CONTROL CASE, AIMS AT THE CENTER OF THE N ON W SIDE OF METER.

Meter should now indicate correctly





$$\begin{array}{r}
 14.3 \overline{) 4920.} \\
 \underline{429} \phantom{0} \\
 630 \\
 \underline{572} \\
 580
 \end{array}$$

$$2 \overline{) 34.4} \quad 17.2$$

$$172.4''$$

$$\begin{array}{r}
 12 \\
 \underline{.2} \\
 2.7
 \end{array}$$

$$\begin{array}{r}
 23.3 \\
 \underline{422} \\
 700 \\
 \underline{633} \\
 670 \\
 \underline{633} \\
 37
 \end{array}$$

14.

$$\begin{array}{r}
 21.1 \\
 \underline{2} \\
 422 \\
 \underline{211} \\
 1477
 \end{array}$$

21

$$\begin{array}{r}
 12 \\
 \underline{3/4} \\
 3.1
 \end{array}$$

$$23.3$$

$$\begin{array}{r}
 23.4'' \\
 \underline{11} \\
 23.4'' \\
 \underline{11} \\
 11.8''
 \end{array}$$

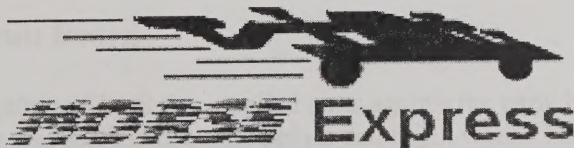
$$11.8''$$



# ASSEMBLY INSTRUCTIONS

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## T-Tone Code Practice Oscillator



Division of Milestone Technologies, Inc

**10691 E. Bethany Drive, Suite 800  
Aurora, CO 80014**

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# Morse Express T-Tone

## Code Practice Oscillator Kit

### Introduction

The T-Tone is a Code Practice Oscillator (CPO) with wave shaping. It uses a Twin-T oscillator which feeds a sine wave into an LM-386 audio amplifier with adequate output for headphones or a small speaker. The frequency of the tone is variable via an onboard trim-pot. The oscillator runs continuously, and its output is grounded through the 2N7000 MOSFET keying transistor. This results in almost instantaneous rise and fall times, and the ability to shape the wave train, so that clean, pleasant-sounding Morse code can be produced even at high speeds with an electronic keyer. Our thanks to Charles J. Olson, WB9KZY for the circuit/board design.

### General Construction Notes

The semiconductors (the two transistors and the IC) should be handled as little as possible to prevent static damage. You should use a grounding strap and anti-static mat if available or at the very least, be sure to touch ground prior to touching these parts.

The solder pads and traces are small and delicate— you should use a low power (15-25W) or temperature-controlled soldering iron with a very fine tip. The board is double sided (that is, there are solder traces on both top and bottom, and the holes are plated-through). Inspect each solder connection as you go, and make sure you have good connections with no solder-bridges. Refer to the solder trace images when in doubt about solder bridges. Be particularly careful when there are two holes on the same solder pad— don't let the solder fill the empty hole! Fresh, good quality solder with a low-residue flux will make the job much easier.

### Assembling the Circuit Board

**Step 1)** Get the parts together. Check the supplied parts against the parts list, and resolve any discrepancies or anything you don't understand before you begin work. The parts list is divided into parts which are installed on the circuit board, and parts which are external, that is, connected to the board with wires.

**Step 2)** Familiarize yourself with the components. Most of the components should be fairly easy to identify and place - see the parts list and the parts placement diagram for descriptions. The orientation of the electrolytic capacitors (C5, C6 and C7) is critically important because they are polarized. C5 is a small yellow “tantalum” cap; the *positive* (+) side is marked on the slightly bumped out side of the cap. C6 and C7 are electrolytic caps with stripes indicating the *negative* (-) side. With both types of capacitor you will notice that the + lead is longer than the - lead. Be sure to match these polarity marks as shown on the board!

**Step 3)** Orient the board as shown, with the printed letters reading correctly as you would read them on a printed page. Install the parts one or two at a time, as described in the steps below. Form the leads as required, and trim the leads after soldering.



- ☒ 3.1 The 8 pin DIP socket is installed at U1 near the center of the board. The notch on the end of the socket should be oriented toward the left. Straighten the pins if necessary, insert into the 8 matching holes and solder one pin. Make sure the socket is oriented correctly and flat against the board. Reheat and adjust if necessary. Solder all 7 remaining pins.
- ☒ 3.2 R2 and R3 are 18K Ohm resistors (marked brown, gray, orange, gold). Place R2 and R3 to the left of the IC socket (C1 will go between R3 and the IC socket) and solder in place.
- ☒ 3.3 R6 is a 2K Ohm resistor (red, black, red, gold). Place R6 as shown on the parts placement diagram, near the bottom edge of the board near the hole marked "Key." Solder in place.
- ☒ 3.4 R8 is a 10K ohm resistor (brown, black, orange, gold). Place R8 as shown on the parts placement diagram, along the right edge of the circuit board and solder in place.
- ☒ 3.5 R1 is a 4.7K Ohm resistor (yellow, violet, red, gold). Place R1 above the IC socket and solder in place.
- ☒ 3.6 R9 is mounted vertically to the left of the IC socket. Use *either* the "zero ohm resistor" (resistor body with single black band) for maximum volume, with some distortion at higher volume levels, *or* the 330K Ohm resistor (orange, orange, red, gold) to reduce the output volume.
- ☒ 3.7 R10 is a 10 Ohm resistor (brown, black, black). Place R10 near the upper right corner of the IC socket and solder in place.
- ☒ 3.8 C8 is a .047uF blue mono cap marked 473. Place C8 in the upper right corner, above R10, and solder in place.
- ☒ 3.9 C5 is a 2.2 uF yellow Tantalum capacitor. Place C5 as shown on the parts placement diagram, just to right of the IC socket with the positive lead in the hole that is marked + and solder in place.
- ☒ 3.10 C6 is a 100 uF electrolytic capacitor. Place C6 as shown near the top center of the board, with the positive lead in the hole marked + and solder in place.
- ☒ 3.11 R7 is a 20K Ohm trim pot marked 203 or 24E. Place R7 as shown on the parts placement diagram in the lower right side of the board with the flat edge of R7 oriented toward the bottom of the board. Adjust the leads as necessary to fit, and solder in place.
- ☒ 3.12 R4 is a 10K Ohm trim pot marked 103 or 14E. Place R4 as shown on the parts placement diagram near the lower left corner of the circuit board. Adjust the leads as necessary to fit, and solder in place.
- ☒ 3.13 Q1 is a 2N7000 transistor (remember that this part is static sensitive) . Place Q1 as shown on the parts placement diagram just below the IC socket with the flat edge of Q1 oriented toward the IC socket and solder in place.



- ☒ 3.14 Q2 is an MPSA42 transistor. Place Q2 as shown near R2 and C4, with the flat edge of Q2 oriented toward R2 and solder in place.
- ☒ 3.15 C7 is a 4.7 uF electrolytic capacitor. Place C7 as shown below the IC socket and above R6, parts placement diagram, at the right center of the circuit board with the negative stripe to the left side of the circuit board (away from the right edge) and solder in place
- ☒ 3.16 C1 and C4 are .047 uF green polyester capacitor marked 2A473. Place C1 between R3 and the IC socket. Place C4 on the left side of the board with one end toward R2 and C1 between R3 and the IC socket as shown. Solder the two capacitors in place.
- ☒ 3.17 C2 and C3 are .018 uF green polyester capacitors marked 2A183. Place C2 and C3 as shown on the left side of the board and solder in place.
- ☐ 3.18 Form the leads of U1 (the LM386 8 pin DIP audio amplifier IC) by gently rolling the pins against a hard surface so that they are perpendicular to the surface of the IC. Insert the IC into the socket at U1, with the pin one dot on the same end as the notch in the socket.

**Step 4) Check your work!** . Take the time to check the top and the bottom of the board for solder bridges. Double check the orientation of the polarized components such as U1, the transistors, and the electrolytic caps C7, C6 and C5.

The construction of the board is now complete, and it is time to connect the off-board components. It is recommended that you “bench wire” the components and test the oscillator before you install it in an enclosure. Only the RCA jacks (key input and line out) will need to be unsoldered to mount it in a box.

## Off-board Parts Connection

**Step 5)** Refer to Figure 2 and the parts overlay diagram to see how the connections are made in accordance with the following instructions. If you plan to mount the T-Tone in an enclosure, consider how everything will be arranged in the box, so you can use appropriate wire lengths. We suggest 3" in the following instructions but you can make the wires longer or shorter to suit, keeping in mind that we are working with audio here, so excess wire length should be avoided.

- ☐ 5.1 Locate the 100K Audio Pot with Switch (R5/SW1). With the pot held as shown in Figure 3 (with the shaft up and the three terminals facing you), the wiper is the terminal in the middle.
- ☐ 5.2 Cut three pieces of wire about 3" inches in length (depending on how close you will mount the pot to the circuit board). Strip 1/4" of the insulation off the ends of the three wires. Solder one end of each wire to each of three pot terminals.
- ☐ 5.3 Connect the three wires to the circuit board as follows. Locate the three holes on the upper left side of the board, between C4 and the corner mounting hole. Connect the wire from the wiper (center terminal) to the middle hole. Connect the wire from the terminal to the LEFT



of the wiper to the hole ABOVE the one you just used, that is, closest to the corner. Connect the wire from the terminal that is to the RIGHT of the wiper to the remaining hole.

- 5.4 Install the knob on the pot (or leave it for later if you can comfortably turn the shaft by hand). Turn the pot fully counterclockwise until it clicks (this is the off position for the switch).
- 5.5 Locate the 9V battery snap. Solder the RED wire from the battery snap to one of the switch terminals on the 100K Audio Pot. The switch terminals are opposite each other and nothing has been connected to them yet. Solder a 3" piece of wire to the other switch terminal. Connect the other end of this wire to the circuit board at +V on the upper edge of the board, and connect the black lead from the battery snap to the ground hole next to +V.
- 5.6 Connect a wire between the center terminal of an RCA jack and the hole on the lower edge of the board marked Key. Connect a second wire from the solder lug on the jack to the ground hole next to Key.
- 5.7 Connect a wire between the center terminal of the other RCA jack and the hole near the upper left corner of the board, marked L on the overlay diagram. Connect a second wire from the solder lug on the jack to the ground hole next to L..
- 5.8 The speaker may have wires attached, with a plug on the end. Remove the plug and strip the leads to leave about 1/4" of bare wire. If there are no wires attached to the speaker, cut two pieces of wire and strip the ends, then connect one to the + terminal on the speaker and the other to the - terminal. Connect the red wire (or the one connected to + on the speaker) to the hole marked "out" on the circuit board, at the top edge to the left of C6. Connect the black wire (or -) to the hole marked "gnd."

## Operation

Connect a 9V battery to the battery snap, and plug in your key or the output from an electronic keyer.

Turn the knob on the audio pot clockwise until it clicks "on." You should hear a slight "pop" from the speaker. Close the key and adjust the audio pot for a comfortable listening level.

With the key down, or the paddle closed to send a string of dots, adjust R4 for the desired tone frequency.

The duty cycle pot (R7) is used to adjust the "wave train" for a series of dots at relatively high speed (25WPM or more) sent by an electronic keyer. R7 adjustment is usually unnecessary unless you are using the CPO for practice with a paddle and electronic keyer. It can be most easily adjusted using an oscilloscope, in which case you are looking for a relatively sharp, square wave train when the keyer is sending dots. Adjust your scope so that the dots look like a series of boxcars moving across the screen. As R7 is adjusted, you may see the wave train turning into a series of "lozenge" shapes, and the tapering on the leading and trailing ends is what you want to adjust out. If you don't have a scope, R7 can be adjusted by ear so that the wave train is roughly even (the dots start and stop cleanly).



The volume control pot (R5) controls both the audio volume from the speaker and the level of the Line Out signal. You can achieve more volume (and a higher level Line Out signal) by using a higher supply voltage (up to about 14 volts) but you may encounter distortion at higher volume settings.

## Installation in Enclosure

Virtually any enclosure can be used, plastic or metal, but plastic is certainly easier to work with. Decide where you want to locate the speaker, volume control pot, and key input jack. Drill a pattern of holes within a 2" circle where you will install the speaker. Drill a 5/16" hole for the volume control pot and two 1/4" holes for the RCA jacks. Install the pot and the jacks, and attach the speaker to the other side of the panel using superglue, hot-melt glue, or other convenient adhesive (be careful not to damage the paper cone of the speaker). The board and battery can "float" in the box, or they can be held in position with pieces of foam, or secured with adhesive tape.

## Using the T-Tone for Audio Morse Transmission

Because of the clarity of the T-Tone's sine wave output (when properly adjusted) it is ideal for transmission of Morse using an FM transmitter whether all mode, mobile, or hand-held. The audio output from the T-Tone becomes the audio input of the transmitter, and the result is an FM carrier with Morse content. The transmission mode is still FM, and the signal has the FM carrier's bandwidth, so this technique should be used only on frequencies where FM transmission is permitted. For the record, "CW" is a transmission *mode* where the "carrier" is the only signal that is transmitted, and the carrier is turned on and off representing the dots and dashes of Morse code. Confusion of the Morse *code* with the CW *mode* can result in inadvertent transmission of the wrong signal type for the frequency in use.

If you are using an FM repeater, you should observe the customary protocols for identifying yourself and breaking for other users.

## Acoustic Coupling of the T-Tone to a Transmitter

By far the easiest way to get T-Tone Morse into an FM transmitter is by "acoustic coupling," that is, letting the transmitter's microphone pick up the sound from the T-Tone's speaker. Just place the microphone about half an inch from the T-Tone's speaker, but be prepared to adjust the volume on the T-Tone and/or the microphone's position if necessary to avoid over-driving the transmitter. If you intend to transmit for more than a few seconds you might want to find some way of locking the "push-to-talk" so you don't have to hold it. Many microphones include a "hot mic" button or physical lock for the PTT switch, but if all else fails you can usually put a rubber band around the mic to hold the switch closed. More elaborate multi-mode radios will often have a VOX circuit, which will often work just fine with audio Morse.



## Direct Coupling of the T-Tone to a Transmitter

*Caution! Incorrect coupling of any device to your radio may damage the radio!* We can only provide guidelines, and will accept no responsibility for any damage that may result. Read your radio's manual, which may include instructions for connecting an audio input device such as a tape recorder.

A "line level" signal is provided at the "line out" jack for input to an external amplifier or transmitter. This is the pure sine-wave signal generated by the oscillator, before amplification by the LM386. The level of this signal is controlled by the volume control pot R5 and the peak voltage will be around 600mV, depending on the power supply voltage.

The audio signal can go into the transmitter through the microphone connector, or on some radios you will find a "line in" jack.

You will also need to consider the PTT situation. Your radio will have a "PTT line" which may be accessible through the microphone connection, or a jack on the back. Or there may be a manual transmit or "MOX" button. The radio will transmit only when the PTT line is closed by a switch, the PTT button on the mic, or by some other means.

We hope you have enjoyed building your T-Tone CPO and that it provides many years of reliable service.

## Specifications

Voltage: +9-12VDC

Current: Idle 25mA Key-down 60mA @9VDC

Pitch: 450Hz to 1.5KHz

Speed: Tested to 40WPM

Line Out:  $\leq 600\text{mVPP}$

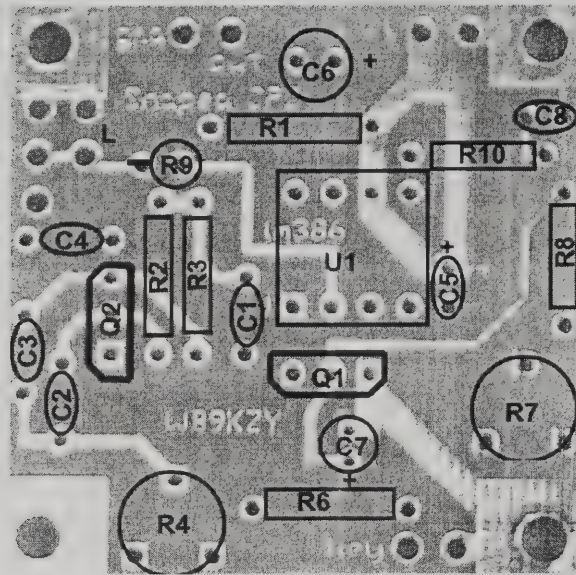


## Parts List

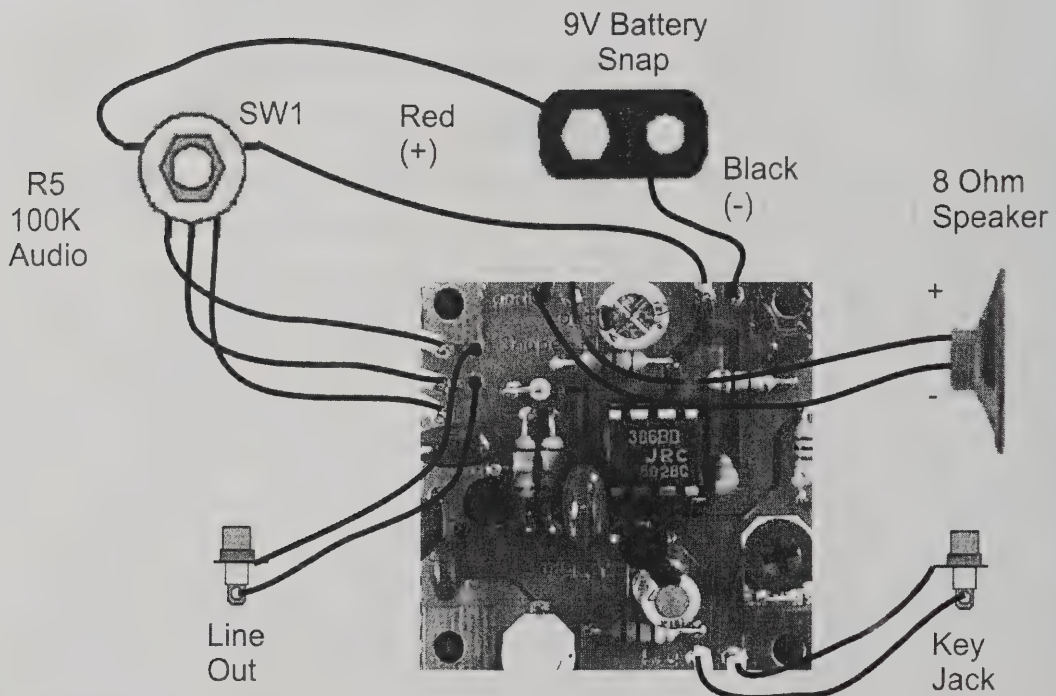
T-TONE PC BOARD PARTS				
1	Part Num.	DESCRIPTION	Ref Des	MARKINGS
1	ICS01	8 PIN DIP IC SOCKET	U1	
1	6-472-14	4.7K Ohm 5% 1/4W Resistor	R1	Yel-Vio-Red-Gld
2	6-183-14	18K Ohm 5% 1/4W Resistor	R2, R3	Brn-Gry-Ora-Gld
1	6-202-14	2K Ohm 5% 1/4W Resistor	R6	Red-Blk-Red-Gld
1	6-103-14	10K Ohm 5% 1/4W Resistor	R8	Brn-Blk-Ora-Gld
1	6-100-14	0 Ohm 1/4W Resistor/Jumper	R9	Blk
1	6-100-14	10 Ohm 5% 1/4W Resistor	R10	Brn-Blk-Blk
1	MC104	.047 uF Mono Cap (blue)	C8	473
2	K701	.047 uF Polyester Cap (green)	C1, C4	2A473J
2	K702	.018 uF Polyester Cap (green)	C2, C3	2A183J
1	K703	2.2uF Tantalum Cap (yellow)	C5	+
1	POT7	10K Ohm Trim Pot	R4	103 or 14E
1	POT8	20K Ohm Trim Pot	R7	203 or 24E
1	2N7000	MOSFET Transistor, TO-92	Q1	2N7000
1	MPSA42	NPN Transistor, TO-92	Q2	MPSA42
1	CE10	100 uF Electrolytic Cap	C6	100uF 16V
1	CE05	4.7 uF Electrolytic Cap	C7	4.7uF 16V
1	LM386	LM386 AUDIO AMP IC	U1	LM386
1		Printed Circuit Board		WB9KZY
T-TONE OFF-BOARD PARTS				
1	K704	100K Ohm Audio Pot w/ Switch	R5/S1	
1	K296	Knob for Audio Pot		
2	K302	RCA Jack, Key In & Line Out		
1	K909	8 Ohm Speaker		
1	K913	9V Battery Snap		
1		Printed Manual		



## Parts Placement (Overlay) Diagram

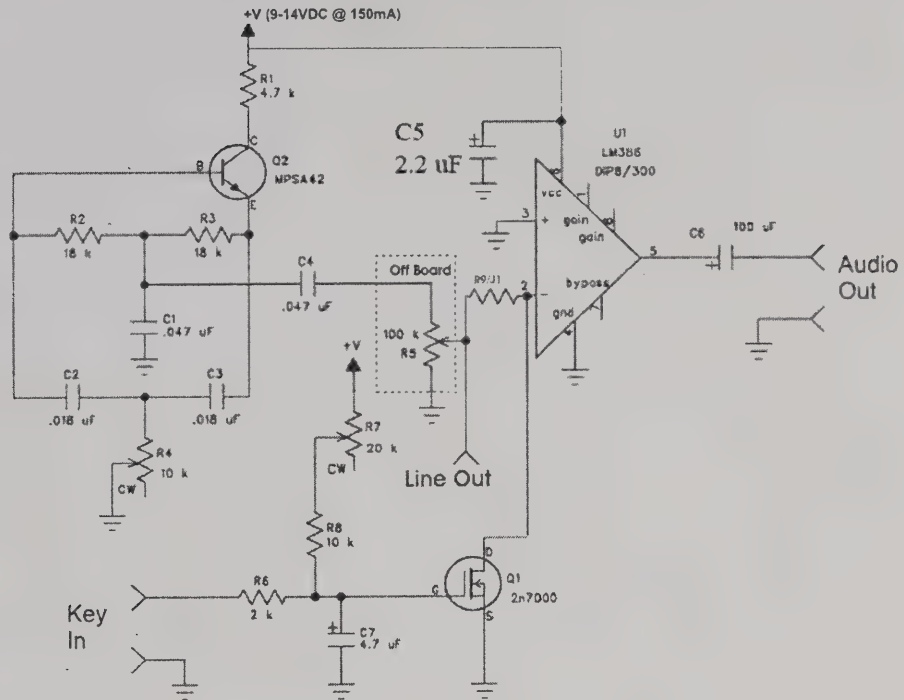


## Wiring Diagram

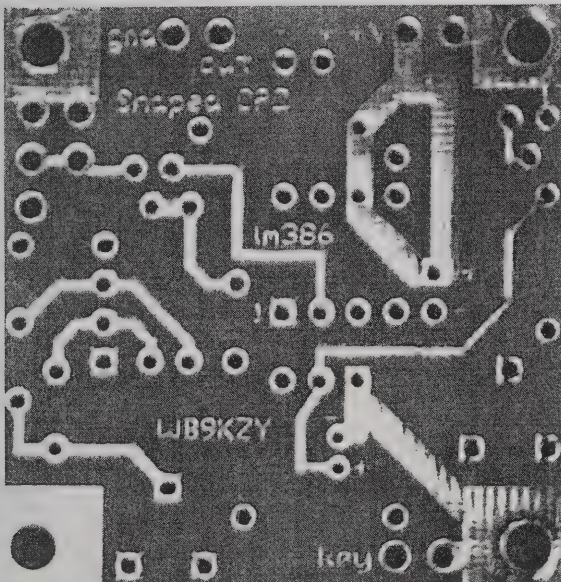




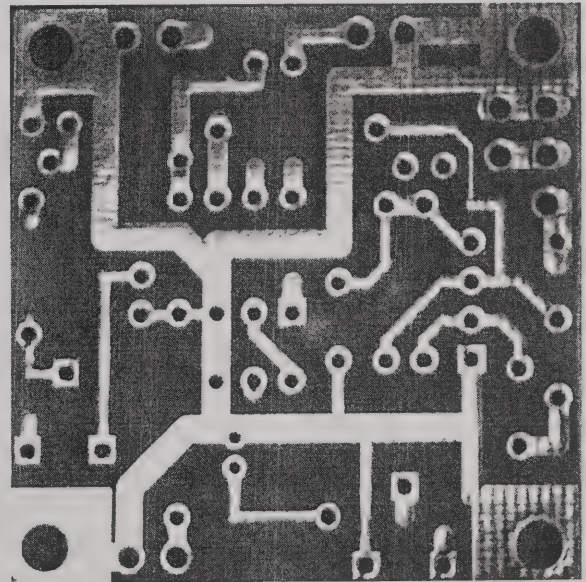
## MX T-Tone CPO Schematic



Solder Map, Top



Solder Map, Bottom









## SPI-RO MANUFACTURING, INC.

P.O. Box 1538 • Hendersonville, NC 28793

### INSTALLATION INSTRUCTIONS

for

#### LC-160 Shorteners & LS-160K Antenna Kit

The LC-160 & LC-160K are designed to make the overall physical length of the 160 meter dipole much shorter. This is ideal for installations that do not have the room for regular length dipoles.

Find a suitable location for the antenna, keeping it away from metal buildings and objects that may interfere with the performance. Always be sure there are no power lines nearby. Keep away from ALL overhead lines. Keep in mind that the overall length will be approximately 100 feet.

\*\*\*\*\*WARNING\*\*\*\*\*

ANY ANTENNA ELEMENTS, WIRES, LEAD-INS OR FEEDLINES SHOULD NEVER COME CLOSE TO, OR CROSS ANY ELECTRICAL LINES. TO AVOID ELECTRICAL SHOCK, STAY AWAY FROM ALL OVERHEAD LINES. NEVER USE ALUMINUM LADDERS, USE WOODEN LADDERS OR SUPPORTS. IT'S ALWAYS GOOD PRACTICE TO HAVE AN EXTRA PERSON ON THE JOB TO HELP LOOK OUT FOR HAZARDOUS CONDITIONS, AND PROVIDE AN EXTRA MARGIN OF SAFETY.

\*\*\*\*\*

For constructing a dipole antenna, the element lengths should be as follows:

From the center connector to shortener

25 feet

From shortener to end insulator

25 feet

It makes no difference which end of the shorteners go toward the center connector.

Leave enough fold-back on the wires next to the end insulators so adjustments can be made (start with approx. 3 feet extra).

It may be necessary to make minor length adjustments to obtain a low SWR. When adjusting element lengths, only adjust the outer sections (next to the end insulators) Do not adjust the sections next to the center connector.

Make adjustments a little at a time. Keep both sides of the dipole at equal lengths. Assemble the antenna on the ground first, laying it out completely in the area of installation.

Mount the center connector as high as possible (at least 20 feet, preferably 30-40 feet.) The ends of the antenna can be mounted lower, in such a manner as an inverted "V". However, the ends should be a minimum of 15 feet above the ground for best results.

Shortened dipole antennas will have a bandwidth narrower than a full  $\frac{1}{2}$  wave dipole. If you wish to increase the bandwidth, a tuner may be required.



Do not turn or apply heat to the side terminals or eyebolts. This can cause internal damage.











# HIGH QUALITY ANTENNAS AND ACCESSORIES

**HIGH VOLTAGE RECTIFIERS**

HS-1 Heat Sink for 7-VTR Series \$4.00

HV-155 - 15KV @ 550 MA \$4.00  
HVR-8 - 8KV @ 1A \$4.50  
HVR-8 - 8KV @ 1A \$8.95  
HVR-10 - 10KV @ 1A \$11.00  
HVR-14 - 14KV @ 1A \$13.00  
HVR-16 - 16KV @ 1A \$16.00



**SPI-RO MANUFACTURING, INC.**  
P.O. Box 5500  
Lakeland, Florida 33807



## SAVE UP TO \$12 ON YOUR ANTENNA PURCHASE

### ANTENNAS IN KIT FORM

For those who prefer to assemble their own. Same components as used in our factory assembled antennas. Easy to follow instructions and measurements for element lengths included.

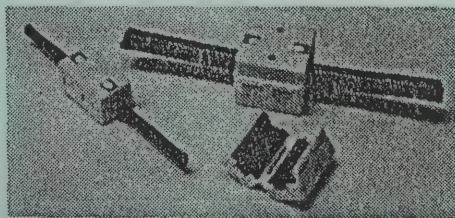
Antenna Model	Assembled Price	Kit Form Model	Kit Form Price
D-32	\$64.95	D-32K	\$58.95
D-42	\$69.95	D-42K	\$62.95
D-52	\$74.95	D-52K	\$67.95
D-162	\$84.95	D-162K	\$77.95
VS-31	\$49.95	VS-31K	\$44.95
VS-41	\$54.95	VS-41K	\$49.95
VS-53	\$79.95	VS-53K	\$72.95
VS-64	\$98.95	VS-64K	\$91.95
D-34	\$85.95	D-34K	\$76.95
D-44	\$92.95	D-44K	\$83.95
D-54	\$102.95	D-54K	\$93.95
D-56	\$119.95	D-56K	\$109.95
D-68	\$154.95	D-68K	\$142.95
MD-6	\$21.95	MD-6K	\$17.95
MD-10	\$23.95	MD-10K	\$18.95
MD-15	\$23.95	MD-15K	\$18.95
MD-20	\$24.95	MD-20K	\$19.95
MD-30	\$26.95	MD-30K	\$21.95
MD-40	\$27.95	MD-40K	\$23.95
MD-80	\$32.95	MD-80K	\$26.95
MD-160	\$44.95	MD-160K	\$37.95

## FERRITE PRODUCTS

### RFI & TVI Solutions

"Interference Kit-#RFI-2" - \$34.00 value ONLY \$17.95 plus \$3.00 shipping\*. Includes assortment of ferrite Toroids, Beads and Split Beads, for keeping interference out of T.V.s, Stereos, Computers, Telephones, etc. Instructions and Tech Sheet included. Other Kits and Ferrites available.

(\*Canada orders add \$4.00 shipping)



**RFI-TVI SOLUTIONS!** "Interference Kit RFI-1", SPLIT BEADS. \$49.50 Value, ONLY \$32.95, plus \$3.00 shipping. Includes 12 sets, with EASY-SNAP cases! Keep interference out of telephones, TV's, Amateur Radio Equipment, Computers, etc.



**ORDERS ONLY - 1-800-728-7594**  
**FREE BROCHURE & INFORMATION - 813-646-7925**  
**FAX - 813-646-0539**

**SPI-RO MANUFACTURING, INC.**

P.O. Box 5500, Lakeland, FL 33807

## Quick Find Index

### Product

### Block Number

#### Antennas:

All Band .....	3, 4
Antenna Kits .....	21
Limited Space .....	10
Multi-Band Trap Dipole .....	5, 9
Multi-Band Trap Sloper .....	6
Receiving, SWL .....	14
Single Band .....	15
Baluns .....	20
Center Connectors .....	11, 20
Coax Cable, Feedlines .....	8
Coax Connectors, Adaptors .....	11
Coax Seal .....	8
Insulators .....	11
Inter-connect Cables, Coax .....	7
Lightning Protectors .....	16, 18
Rope, Support .....	7
Shorteners, Antenna .....	19
Surge Protectors, Power Line .....	13
Traps, Antenna .....	19
Wire & Cable .....	7, 8

Block 1

## ALL BAND DIPOLE ANTENNA

- 135 feet Overall Length
- Perfect match for your Antenna Tuner with balanced line output
- Works ALL Bands 160 thru 10 Meters
- Handles Full Power
- Factory assembled — Ready to install — NO adjustments necessary
- Install as Flat-top, Sloper, Inverted "V", or almost any configuration
- Utilizes Heavy 14 ga stranded CopperClad (CopperWeld) antenna wire. (30% copper, 70% high-strength steel) NO rust. Will not stretch like copper.
- INCLUDES 100 feet of 450Ω feedline
- Feedline can be shortened
- Provides excellent SWR on all bands
- Works with ALL transmitters, transceivers and receivers
- Instructions included

**Model A-10 \$37.95**

Block 3

## TOP QUALITY



- ★ **STATE OF THE ART COMPONENTS**
- ★ **THE BEST YOU WILL FIND**



Why? Because SPI-RO MANUFACTURING has designed and machined its own terminals out of Solid Brass that eliminate the need for jumper wires, and eliminates the need for soldering.

Long needed by the Amateur Radio Operator, a better connection system — NOW IT IS HERE — NOW IT IS EASY TO MAKE ANY ADJUSTMENTS YOU WANT WITHOUT THE HASSLE AND AGGRAVATION YOU'VE BEEN BURDENED WITH.

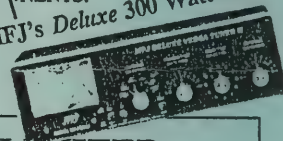
**Top Quality • Ease of Installation • Weatherproof  
 Rust Free • Maximum Power • Dependability**

*It's all here for you now, ONLY from SPI-RO MANUFACTURING, INC.!*

ALL OF OUR ANTENNA  
 HIGH QUALITY

INCLUDE THESE  
 COMPONENTS.

**MFJ's Deluxe 300 Watt Tuner**



\*\*\*\*\* COMBO SPECIAL - IAS-2-SP \*\*\*\*\*  
 AS-2 - ALL BAND Antenna with popular MFJ-949D Ant.  
 Tuner only \$183.95!  
 And get a 18" RG-8X Interconnect cable FREE!!

## ALL BAND — LIMITED SPACE ANTENNA

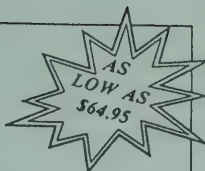
- Only 70 feet Overall Length!
- Shortened antenna, perfect match for your antenna tuner with balanced line output
- Works ALL Bands 160 thru 10 Meters
- Shorteners provide full 135 feet electrical length; with only 70 feet physical length!
- Handles Full Power
- INCLUDES 100 feet of 450Ω feedline
- Feedline can be shortened
- Perfect for ALL classes of Amateurs
- Works with ALL transmitters, transceivers, and receivers
- Sealed, weatherproof, lightweight shorteners utilize NO rust terminals
- Factory assembled — Ready to install — NO adjustments necessary
- Install as Flat-top, Inverted "V", Sloper, or almost any configuration
- Provides excellent SWR on all bands
- Utilizes Heavy 14 ga stranded CopperClad (CopperWeld) antenna wire; (30% copper, 70% high-strength steel) NO Rust. Will not stretch like copper.
- Instructions included

**Model AS-2 \$49.95**

Block 4



## MULTI-BAND TRAP ANTENNAS



Deluxe



### FEATURES:

- Factory Assembled, Ready to Use
- Lightweight, Sealed, Weatherproof Traps
- Deluxe Center Connector/Insulator has SO-239 Receptacle that accepts Standard PL-259 Connector
- Only One Feedline to Work All Bands
- Excellent for ALL Class Amateurs
- For All Transmitters, Receivers and Transceivers
- Commercial Quality, Built to Last
- 600 watt power rating
- Antenna Tuners Usually Never Required
- Low-Loss End Insulators
- Automatic Band Switching
- Extra Strong 14-gauge Stranded CopperWeld Antenna Wire
- Use as Inverted "V" or Flat Top
- Instructions Included

★ Traps are individually tested and measured, to give you the most efficient operating antenna!

- D-32** 3-Band operation covers 20, 15, 10 Meters  
Overall length approx. 27 feet, w/ 2 traps ..... **\$64.95**
- D-42** 4-Band operation covers 40, 20, 15, 10 Meters  
Overall length approx. 55 feet, w/ 2 traps ..... **\$69.95**
- D-52** 5-Band operation covers 80, 40, 20, 15, 10 Meters  
Overall length approx. 105 feet, w/ 2 traps ..... **\$74.95**
- D-162** 2-Band operation covers 160 & 80 Meters  
Overall length approx. 208 feet, w/ 2 traps ..... **\$84.95**

See Block 8 for Coax Specials!

★ 10-Day Money Back Guarantee!

"Pro-Balun" in place of Deluxe Center Connector; Add \$9 to Antenna Price

Block 5

("PRO-BALUN" NOT AVAILABLE WITH D-162)

## MULTI-BAND TRAP ANTENNAS

Professional Series



### FEATURES:

- The Ultimate in "Trap" Design
- Works as completely independent antennas
- Factory Assembled, Ready to Use
- Heavy Duty 14-gauge Stranded CopperWeld Wire
- For All Transmitters, Receivers and Transceivers
- Automatic Band Switching
- Traps are individually tested and calibrated, to give you the most efficient operating antenna!
- 4, 6 and 8 Trap Design, Improves SWR
- Commercial Quality, Built to Last
- For ALL Class Amateurs
- Lightweight, Sealed, Weatherproof Traps
- 600 watt power rating
- Antenna Tuners usually never required
- Deluxe Center Connector/Insulator, with SO-239 Receptacle, that accepts standard PL-259 Connector
- Use as Inverted "V" or Flat Top
- Instructions included
- 10-Day Money Back Guarantee!

- D-34** 3-Band Operation covers 20, 15, 10 Meters  
Overall length approx. 24 ft, w/ 4 traps ..... **\$85.95**
- D-44** 4-Band Operation covers 40, 20, 15, 10 Meters  
Overall length approx. 47 ft, w/ 4 traps ..... **\$92.95**
- D-54** 5-Band Operation covers 80, 40, 20, 15, 10 Meters  
Overall length approx. 97 ft, w/ 4 traps ..... **\$102.95**
- D-56** 5-Band Operation covers 80, 40, 20, 15, 10 Meters  
Overall length approx. 82 ft, w/ 6 traps ..... **\$119.95**
- D-68** 6-Band Operation covers 160, 80, 40, 20, 15, 10, Meters  
Overall length approx. 146 ft, w/ 8 traps ..... **\$154.95**

See Block 8 for Coax Specials

"Pro-Balun" in place of Deluxe Center Connector; Add \$9 to Antenna Price

Block 9

("PRO-BALUN" NOT AVAILABLE WITH D-68)

## MULTI-BAND TRAP VERTICAL "SLOPER" ANTENNAS

GREAT FOR "DX"  
PORTABLE or PERMANENT USE!  
FAST-EASY INSTALLATION

PRICES START  
AS LOW AS  
**\$49.95**

GREAT FOR:



### FEATURES:

- Factory Assembled, Ready to Use
- Lightweight, Sealed, Weatherproof Traps
- Automatic Band Switching
- 600 watt power rating
- For All Transmitters, Receivers, and Transceivers
- Installs in only minutes!
- Use as Vertical or "Sloper"
- Commercial Quality, Built to Last
- Can be used without Radials
- Extra Strong 14-gauge Stranded CopperWeld Antenna Wire
- Antenna Tuner usually never required
- Deluxe Feed Connector/Insulator has SO-239 Receptacle that accepts Standard PL-259 Connector

★ 10-Day Money Back Guarantee!

Antennas are shipped with the following:  
Completely assembled, with 1, 2, 3 or 4 traps as indicated below. Deluxe Coax Feed Connector/Insulator, Low Loss End Insulator. Instructions included.

- VS-31** 3-Band operation covers 20, 15, 10 Meters  
Overall length approx. 14 ft, w/ 1 trap ..... **\$49.95**
- VS-41** 4-Band operation covers 40, 20, 15, 10 Meters  
Overall length approx. 28 ft, w/ 1 trap ..... **\$54.95**
- VS-53** 5-Band operation covers 80, 40, 20, 15, 10 Meters  
Overall length approx. 42 ft, w/ 3 traps ..... **\$79.95**
- VS-64** 6-Band operation covers 160, 80, 40, 20, 15, 10 Meters  
Overall length approx. 73 ft, w/ 4 traps ..... **\$98.95**

See Block 8 for Coax Specials

"Pro-Balun" in place of Deluxe Center Connector; Add \$9 to Antenna Price

Block 6

("PRO-BALUN" NOT AVAILABLE WITH VS-64)

## For Limited Space... SHORTENED DIPOLE ANTENNAS



### FEATURES:

- Reduces Overall Length of Antenna over 40%!
- Utilizes Loading Coils of "Shorteners". Excellent where limited space is available
- Easy to Assemble Kit Form
- Commercial Quality, Built to Last
- Handles Full Power, 1000 Watts plus
- Loading Coils are Enclosed, Sealed, Weatherproof, and Lightweight
- No Rust Deluxe Connectors
- Antenna Tuners usually never required
- Extra Strong 14-gauge Stranded CopperWeld Wire
- Excellent for ALL Class Amateurs
- For All Transmitters, Receivers and Transceivers
- Deluxe Center Connector/Insulator has SO-239 Receptacle that accepts standard PL-259 Connector
- Use as Inverted "V" or Flat Top
- Easy-to-follow Instructions Included

MODEL	COVERS	OVERALL LENGTH	PRICE
LS-40K	40 Meters	Approx. 38 feet	<b>\$47.95</b>
LS-80K	75/80 Meters	Approx. 69 feet	<b>\$53.95</b>
LS-160K	160 Meters	Approx. 100 feet	<b>\$54.95</b>

See Block 8 for Coax Specials

"Pro-Balun" in place of Deluxe Center Connector; Add \$9 to Antenna Price

Block 10

("PRO-BALUN" NOT AVAILABLE WITH LS-160K)

## WIRE & CABLES

### ANTENNA WIRE

CopperClad antenna wire is copper coated steel that has the strength and "no stretch" ability of steel wire plus the excellent conductivity of copper wire. This wire is 14 gauge and in the standard form which gives great flexibility.

CW-50	50 feet	\$7.50
CW-75	75 feet	\$10.25
CW-140	140 feet	\$16.75
CW-500	500 feet	\$55.00

### SOLID COPPER ENAMELED WIRE (magnet wire)

Single conductor, solid copper, double coated with a heavy enameled finish. This provides excellent solvent resistance and dielectric characteristics. Its popular use is for coil winding and wire antennas. (14 ga. not recommended for spans over 60 feet).

(other sizes & quantities available by special order)

C-20-200	20 ga/200 feet	\$10.95
C-18-200	18 ga/200 feet	\$12.25
C-16-200	16 ga/200 feet	\$16.50
C-14-100	14 ga/100 feet	\$10.95
C-14-200	14 ga/200 feet	\$18.50

### SUPPORT ROPE

High quality double braided dacron rope that is excellent for supporting antennas. Long lasting, high strength.

R-332	3/32" dia.	9¢ per foot
R-316	3/16" dia.	12¢ per foot

### POPULAR INTER-CONNECT COAX CABLES

Excellent for hooking up SWR meters, tuners, coax switches, dummy loads, lightning protectors, etc. All cables below have factory installed PL-259 type connectors installed on each end.

CC-58-2	RG-58/52Ω; Set of 2 cables: 1=12", 1=18"	\$7.95 set
	With any \$20 purchase	\$5.95 set
CC-8-2	RG-8/52Ω; Set of 2 cables: 1=14", 1=20"	\$8.95 set
	With any \$20 purchase	\$6.95 set

Block 7

## WIRE & CABLES

COAX CABLE (includes PL-259 connector on each end)

### COAX CABLE



Coax Cable feedlines are for connecting transmitters and/or receivers to the antenna. The cables listed below are furnished with PL-259 type connector installed on each end.

RG-58U; 52Ω, Handles 600 watts @ 10 Mhz. Loss is 1.4 db per 100 ft. @ 10 Mhz. O.D. = .195"		
Part Number	Length	w/Antenna Purchase Separately
RG-58-50	50 feet	\$11.00 \$13.95
RG-58-90	90 feet	16.00 19.95

RG-59; 75Ω, Handles 800 watts @ 10 Mhz. Loss is 1.1 db per 100 ft. @ 10 Mhz. O.D. = .242"		
RG-59-50	50 feet	\$11.00 \$13.95
RG-59-90	90 feet	16.00 19.95

RG-8X; 50Ω, Handles 1000 watts @ 10 Mhz. Loss is 0.8 db per 100 ft. @ 10 Mhz. O.D. = .242"		
(most popular because of size, flexibility, power capability & low loss)		
RG-8X-50	50 feet	13.95 18.95
RG-8X-100	100 feet	20.95 26.95

RG-8; 50Ω, Handles 2500 watts @ 10 Mhz. Loss is 0.55 db per 100 ft. @ 10 Mhz. O.D. = .405"		
RG-8-50	50 feet	25.75 30.95
RG-8-100	100 feet	42.50 47.95
RG-8-150	150 feet	62.00 66.95



### LADDERLINE

Commonly used with balanced output antenna tuners; impedance is 450Ω, and handles power. CopperClad conductors give added strength to prevent breaking & stretching.

LL - (xx) purchase by the foot (minimum order 50 ft.) 16¢ per foot.

### HAND MOLDABLE PLASTIC

### COAX-SEAL



Seals coax connections from moisture and corrosion. A hand moldable plastic material which quickly and effectively seals all types of fittings of all shapes. Stays flexible for years. Can be removed and reused over again. Packed fresh, instructions included.

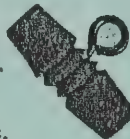
CS-2	2ft. (enough for 4 connections)	\$1.25
CS-5	5 feet	\$2.25
CS-10	10 feet	\$4.25
CS-12	12 feet	\$5.00

Block 8

## ACCESSORIES

### CL-1 "Ladderline Center Connector"

- Simple effective center connector can be used in many configurations.
- Stainless steel eye-hook
- Perfect spacing for 450Ω ladderline.



CL-1 \$1.50

### EI-2 Antenna End Insulators

Low loss, 2 1/2" long, \$1.75 pair

### Coax Connectors; PL-259, "UHF" series, mates with the SO-239 receptacle



259-5	For use on RG-58 cables	\$1.50 ea.
259-6	For use on RG-8X & RG-59 cables	\$1.50 ea.
259-8	For use on RG-8 cables	\$1.25 ea.

For TEFLON add \$1.00 to prices (add T to part#)

### #359 Angle Adaptor

Without doubt, the most popular "elbow" adaptor for your station! Eliminate cabling problems that hold your equipment out from the wall. Do away with those sharp cable bends with this UHF type adaptor. (compatible with PL-259 type connectors).



#359 \$2.50

Block 11

## UHF CONNECTOR



#358  
\$3.25

"T" Adaptor F/M/F



#PL-258  
\$1.50

Double Female Splice



#UHF/DM  
\$2.25

Double Male



#SO-239  
\$1.75

Chassis Mount Receptacle

Block 12





## SINGLE-BAND DIPOLE-ANTENNA

### FEATURES:

- Completely Assembled
- Commercial Quality, Built to Last
- Handles Full Power, 1000 Watts plus
- Tuners usually never required
- Use as Inverted "V" or Flat Top
- Complete with Low Loss End Insulators
- For All Transmitters, Receivers, and Transceivers
- 10-Day Money Back Guarantee!
- Ready to Use
- Lightweight, Sealed Center Connector/Insulator, accepts Standard PL-259 Connector
- Heavy 14-gauge Stranded CopperWeld Wire
- Instructions Included

### ORDER THE MODEL THAT COVERS THE BAND YOU NEED

MODEL	COVERS	OVERALL LENGTH	PRICE
MD-6	6 meter band	9.5 feet	\$21.95
MD-10	10 meter band	16.7 feet	\$23.95
MD-15	15 meter band	22.3 feet	\$23.95
MD-20	20 meter band	33.4 feet	\$24.95
MD-30	30 meter band	45.6 feet	\$26.95
MD-40	40 meter band	66.9 feet	\$27.95
MD-80	80 meter band	133.7 feet	\$32.95
MD-160	160 meter band	260.0 feet	\$44.95

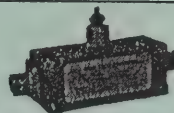
### See Block 8 for Coax Specials

"Pro-Balun" in place of Deluxe Center Connector; Add \$9 to Antenna Price

Block 15

("PRO-BALUN" NOT AVAILABLE WITH MD-160)

## HIGH-TECH ARRESTOR



### Lightning-Surge Protector

Provide protection to your Transmitter, Transceiver, Receiver and Linear Amplifier against damage caused by lightning, static discharges and electro-magnetic pulses! Unit installs in Antenna Coax Feedline. Utilizing the latest technology, the "HIGH-TECH ARRESTOR" will redirect any transient surges away from your equipment and your equipment's chassis.

### THE "HIGH-TECH ARRESTOR" PROVIDES CONTINUOUS PROTECTION

**Protection #1:** The LA-Series of Arrestors utilize a Hermetically sealed gas filled discharge tube. This enables the "HIGH-TECH ARRESTOR" to be activated by surges, such as lightning; diverting them to a safe ground, then restoring itself. The element is approved under F.C.C. Part 68, and meets Military Specs #MIL-48555.

**Protection #2:** In addition to the above, another arresting stage takes over on the stronger surges. While diverting this transient to ground, it also protects the more sensitive stage.

### WE GUARANTEE THE "HIGH-TECH ARRESTOR" FOR 2 FULL YEARS! (details below)

LA-250	For transmitters, transceivers, with a power output up to 250 watts. (to 500 MHz) For ALL Receivers Has standard UHF connectors (SO-239) .....	\$30.95
*LA-2000	For transmitters, transceivers, and power amplifiers with a power output up to 2000 watts (to 500 MHz) Has standard UHF connectors (SO-239) .....	\$32.95

\*Note: The LA-250 is more sensitive than the LA-2000. Even though the LA-2000 will work on all equipment, it is not recommended for use with transmitter output less than 250 watts, or on receivers. If using a linear amplifier, it is recommended the LA-250 be used on the input side, and the LA-2000 on the output side for maximum protection.

Warranty Details: For a period of 2 years from purchase date, Spi-Ro Manufacturing, Inc. will either repair or replace the "HIGH-TECH ARRESTOR" (LA-250 & LA-2000) FREE of charge. Simply return the unit with the original sales receipt, and \$3.75 for shipping & handling to: Spi-Ro Manufacturing, Inc., P.O. Box 5500, Lakeland, FL 33807. This Warranty does not cover physical damage or abuse to the unit.

Block 16

## ANTENNA ACCESSORIES

### ANTENNA TRAPS



These Deluxe traps are made of heavy duty components and housed in weatherproof, sealed enclosures. Rust-free terminals are provided for easy and dependable connections. NO soldering or jumper wires required. 600 watt power rating plus. They are built for long life and will provide years of trouble-free service. All are lightweight. Use 2 traps for Dipole, 1 trap for Vertical Sloper. Complete with easy-to-follow instructions.

T-15	21MHz Trap used for making 3-Band Antenna (20, 15, 10 Meters).	\$18.95 ea.
T-20	14MHz Trap used for making 4-Band Antenna (40, 20, 15, 10 Meters).	\$18.95 ea.
T-40	7MHz Trap used for making 5-Band Antenna (80, 40, 20, 15, 10 Meters).	\$19.95 ea.
T-80	3.5 MHz Trap used for making 2-Band Antenna (160, 80 Meters).	\$19.95 ea.

### SHORTEN YOUR ANTENNA OVER 40%!

Antenna "Shorteners" are used in series with the antenna elements to reduce the physical length. These are excellent where installation space is limited. The shorteners are housed inside weatherproof, sealed enclosures, so NO periodic cleaning is required. Deluxe no-rust terminals insure positive electrical connections. Designed and built for years of trouble-free service. Instructions included.

LC-40	Shortens 40 Meter Antenna to approx. 38 feet overall	\$22.95 pr.
LC-80	Shortens 80 Meter Antenna to approx. 69 feet overall	\$23.95 pr.
LC-160	Shortens 160 Meter Antenna to approx. 100 feet overall	\$24.95 pr.

Block 19

## DELUXE CENTER CONNECTOR

The CE-1 is a center insulator/connector for the dipole or vertical sloper antenna.

- Features:
- NO rust solid brass terminals
  - NO jumper wires needed
  - NO soldering necessary
  - Handles FULL power
  - Completely sealed & Weatherproof
  - Equipped with a SO-239 receptacle, that accepts the standard PL-259 connector • Stainless Eye-hook
  - Easy element adjustments
  - Commercial quality



CE-1  
\$8.95

### "PRO-BALUN"

- 1:1 Impedance Ratio for Dipoles, slopers, inverted "V" 's, beams, etc. Handles full legal power
- Broad Band 3 to 35 Mhz.
- Lightweight, sealed & weatherproof
- Deluxe connectors require NO soldering & NO jumper wires.
- DC grounded for lightning protection
- Equipped with SO-239 receptacle, that accepts the standard PL-259 connector. • Stainless Eye-hook
- Matches 50-75Coax to 50-75 Balanced load
- Minimizes coax & Harmonic radiation by letting your antenna radiate instead of your coax. Converts the unbalanced coax cable feedline into a balanced feed.



PB-1  
\$17.95

Balun PB-4, 4:1 Ratio, \$19.95

Block 20

*Shortened 160 Meter Dipole  
2 coils - 154*

## SURGE PROTECTORS

*"For total electronic surge protection"*



MODEL SP-6-CB \$29.95

- Designed to protect Communications equipment, Computers, Scientific instruments, Satellite equipment, etc., from damaging powerline surges & transients.
- EMI/RFI filter & surge suppressor; UL listed
- Avoid costly repair bills.
- Rated at 15A/125 VAC/60 Hz.
- Quick, easy installation. Simply plug in.
- Protect your investment.
- Voltage spikes can originate from appliances, fluorescent lights, power company changes, and weather. Daily voltage spikes are normal and shorten electronic equipment useful lifetime.
- Nanosecond switching response time; maximum spike current - 4,500 Amps.
- Provides 6 protected outlets, with *resettable circuit breaker*, and *indicator light* that lets you know the internal filter network is operating.

Block 13

## SHORT WAVE LISTENERS LONG WIRE ANTENNA



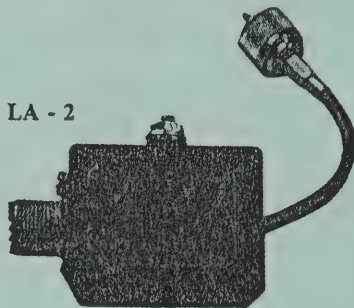
- The SWL-2 is a 100 foot long antenna, made of 14 ga. CopperClad antenna wire.
  - The antenna is fed at one end, and is designed to run from a house or apartment out to a high tree, pole, or support. The element can be cut or bent if space is limited.
  - An insulated lead-in wire 35 feet long is provided to run to the receiver.
  - Also a 25 foot long support rope is provided to support the far end of the antenna.
  - Insulators and instructions are included.
- The unit comes fully assembled and ready to use.

**Model SWL-2 \$26.95**

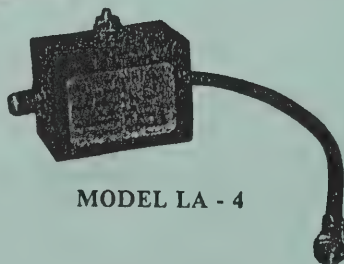
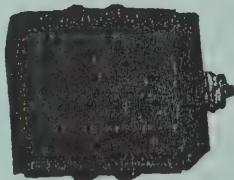
(for lightning protection, order #LA-3 below)

Block 14

MODEL LA - 2



MODEL LA - 3



MODEL LA - 4

Block 17

## LIGHTNING PROTECTION FOR RECEIVERS

(for transmitters see block 16)

- Provides protection to your equipment from harmful voltage spikes, static discharges, un-wanted transients, lightning, etc., that may come in on the antenna line.
- Designed for use with all receivers, and antennas.
- Sensitive gas-filled discharge element(s) diverts any unwanted transients away from your equipment to a safe ground.
- Units can restore themselves for many uses.
- Antenna lines are very vulnerable to these transients; protect your investment, avoid costly repair bills.
- Instructions included.

Model LA-2 For use with coax cable that uses UHF (PL-259) type connectors (50-75 ohms) .....\$19.95

Model LA-3 For Twin lead, 50-300 ohms, screw terminals .....\$22.95

Model LA-4 For coax, 75 ohm, "F" type connectors; TV's, VCR's, etc. ....\$14.95

Block 18



# Invoice

Ship to/Remark  
708-474-1582 phone order  
Charge Visa

Sub-Total	:	57.95
Tax	:	0.00
Total	:	57.95
Payment	:	( 57.95)
Net To Pay	:	0.00





5101930

4783 5500 0227 7563 Exp 11-94

Earl H. Morin

SPI - 0 RFD  
LAKELAND FL  
04033902 CCG

PURCHASER SIGN HERE

X Phone order *Hee*  
Cardholder acknowledges receipt of goods and/or services in the amount of the Total shown hereon and agrees to perform the obligations set forth in the Cardholder's agreement with the issuer.

SAFEPER® U.S. Pat. 4,403,793

QUAN.	CLASS	DESCRIPTION	PRICE	AMOUNT
1		LS-160k Ant. kit		\$54.95
		Shipping		3.00
DATE		AUTHORIZATION		SUB TOTAL
12-17-92		20771		57.95
REFERENCE NO.		REG/DEPT.		TAX
3618		6		
FOLIO/CHECK NO.		SERVER		TIPS
		CLERK		MISC.
SALES SLIP				TOTAL \$57.95

CUSTOMER  
COPY

IMPORTANT: RETAIN THIS COPY FOR YOUR RECORDS

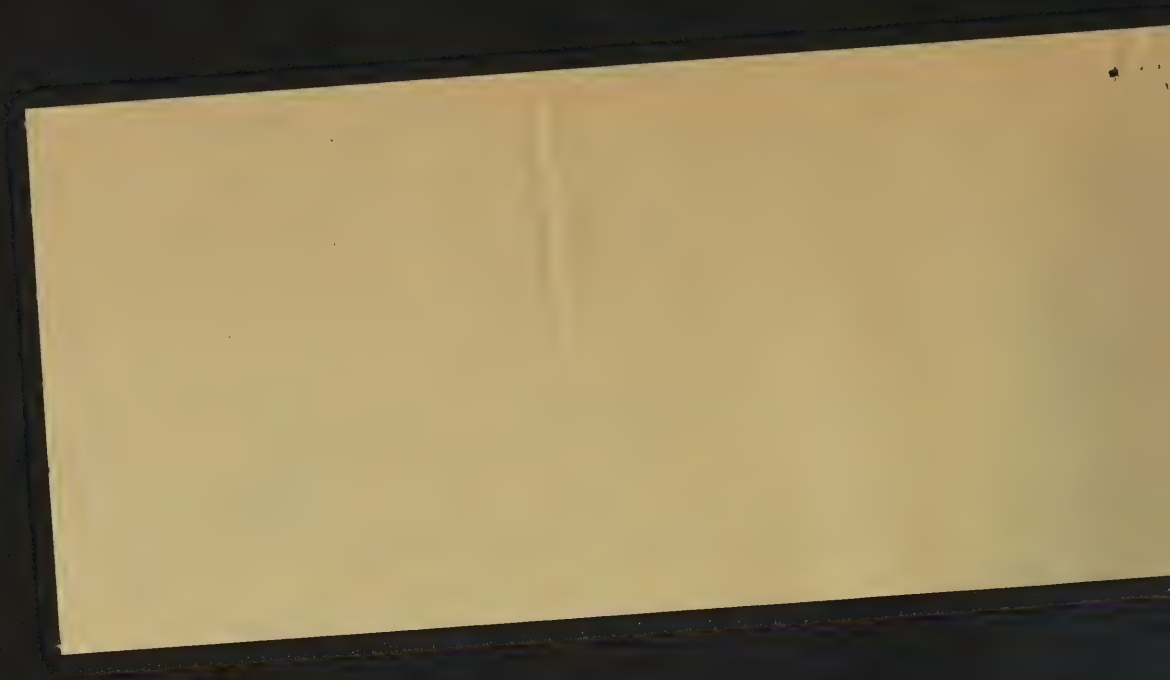




TABLE C

RESISTORS - POWER RATINGS AND TOLERANCES ON KS-SPEC.

TYPE	POWER RATING (watts)	
	KS-13490	KS-13491
	1/2	1
		2

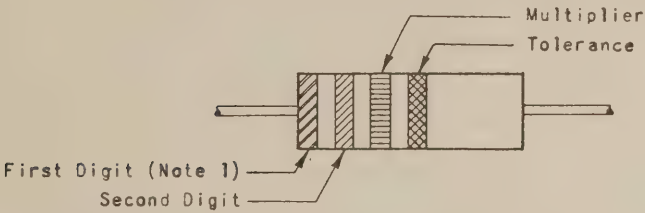
LIST NO. FOR ABOVE RESISTORS	INITIAL MFR TOLERANCE	AFTER SHOP- INSTALLATION OR SHELF-AGING	LONG-TERM OPERATION TOLERANCE (NOTE 1)
L1	±5%	-8 to +11%	-20 to +30%
L2	±10%	-13 to +16%	-25 to +35%
L3	±20%	-23 to +26%	-35 to +45%

NOTES

1. The tolerances in this column should be noted before replacement of resistors in non critical paths.

TABLE D

RESISTORS - COMPOSITION AND LOW POWER, WIRE WOUND



COLOR OF BAND	SIGNIFICANCE OF FIRST TWO DIGITS	MULTIPLIER (See Note 3)	TOLERANCE (See Note 2)
Black	0	1	
Brown	1	10	
Red	2	100	
Orange	3	1000	
Yellow	4	10,000	
Green	5	100,000	
Blue	6	1,000,000	
Violet	7	10,000,000	
Gray	8	100,000,000	
White	9	1,000,000,000	
Gold		0.1	±5%
Silver		0.01	±10%
No Color			±20%

NOTES

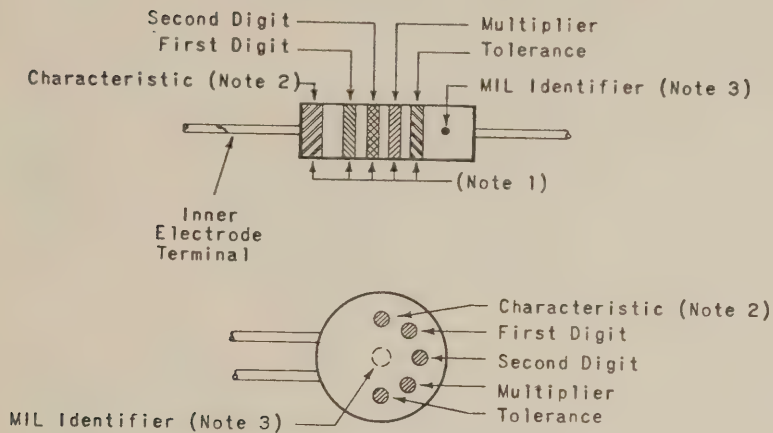
1. Double-width band signifies low-power, fixed, wire-wound resistor.
2. See Table C for tolerances of KS-Spec. composition resistors.
3. The multiplier is the factor by which the first two digits shall be multiplied to obtain the nominal resistance in ohms.



1. The first part of the document is a list of names and addresses. The names are written in a cursive script, and the addresses are written in a more formal, printed style. The list is organized into two columns, with names on the left and addresses on the right. The names are: John Doe, Jane Smith, and Mary Johnson. The addresses are: 123 Main St, New York, NY 10001; 456 Elm St, New York, NY 10002; and 789 Oak St, New York, NY 10003.



TABLE B  
CAPACITORS - CERAMIC DIELECTRIC



COLOR	SIGNIFICANCE OF FIRST TWO DIGITS	MULTIPLIER (See Note 4)	TOLERANCE	
			Nom. Capacitance	
			10 UUF or Less	Over 10 UUF
			Per Cent	
Black	0	1	±2.0	±20
Brown	1	10	±0.1	±1
Red	2	100		±2
Orange	3	1000		±3
Yellow	4	10,000		
Green	5	100,000	±0.5	±5
Blue	6			
Violet	7			
Gray	8	0.01	±0.25	
White	9	0.1	±1.0	±10

## NOTES

1. Colored spots or colored bands may be used.
2. The characteristic is a factor entering primarily into design considerations and has therefore not been included. Colors should match when replacing. Sometimes omitted on KS-Spec. HI-K ceramics.
3. When spots are used, a black spot is applied on the opposite side.
4. The multiplier is the factor by which the first two digits shall be multiplied to obtain the nominal capacitance in micromicrofarads.

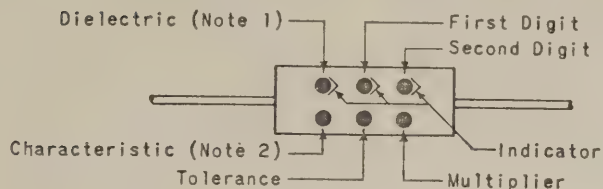
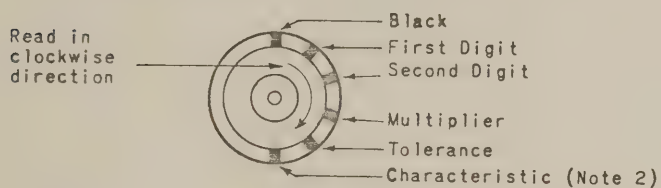
8

●

●



TABLE A

CAPACITORS - MICA OR PAPER DIELECTRICMICA DIELECTRIC, BUTTON STYLES

COLOR OF SPOT	SIGNIFICANCE OF FIRST TWO DIGITS	MULTIPLIER (SEE NOTE 3)	TOLERANCE
Black	0	1	$\pm 20\%$
Brown	1	10	
Red	2	100	$\pm 2\%$
Orange	3	1000	
Yellow	4		
Green	5		
Blue	6		
Violet	7		
Gray	8		
White	9		
Gold		0.1	$\pm 5\%$
Silver		0.01	$\pm 10\%$

## NOTES

1. Silver = paper; black = mica (MIL); white = mica (RETMA).
2. The characteristic is a factor entering primarily into design considerations and has therefore not been included. Colors should match when replacing.
3. The multiplier is the factor by which the first two digits shall be multiplied to obtain the nominal capacitance in micromicrofarads.



## CONTENTS

### 1. INTRODUCTION

### 2. BINARY NUMBERING SYSTEM

#### 1. INTRODUCTION

The binary numbering system and binary counting devices are finding widespread applications in modern switching circuits. Binary devices are particularly well suited to these circuits because they are fast and relatively simple in design. Actually we have been using binary devices in our every day lives for many years. A simple light switch is a binary device. It has two states, on or off. A gas tube is a binary device; it can be conducting or turned off. A relay is a binary device; it is operated or released. Any device, electrical or mechanical, is a binary device if it has two distinct states. Obviously binary devices can be employed to count using the binary numbering system. The purpose of this G.I.C. is to introduce the reader to the binary numbering system.

#### 2. BINARY NUMBERING SYSTEM

##### 2.1 Introduction

A numbering system can be described as an orderly system of marks used to represent quantities for measurement or record. We are familiar with the system of marks called the decimal system which we know as "ten": 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. All other numbers in this system are combinations of these ten different marks. These probably originated from the fact that we have ten fingers that are so handy for counting. Actually any number of marks could be used for our numbering system and we will see that the same rules can be applied for either ten marks or two marks.

##### 2.2 Rules

We use certain rules when counting from habit and common usage without being aware of them. We know that 6 follows 5, and that 100 follows 99, and that 46.30 follows 46.29. The following simple rules govern our use of these ten marks as well as the two marks in the binary system:

(1) The rightmost number is advanced to the next number in the system (e.g. 4 to 5, 6.2 to 6.3, 9.31 to 9.32).

(2) If the rightmost number is the last mark allowed in the system (e.g., 9), change it to the first and move left to the next column and change that mark to the next higher mark in the system. (Thus 69 becomes 70).

(3) If the number in the next left column is also the last mark allowed in the system, continue to apply rule 2 until you reach a column where you can change the mark to the next higher mark (e.g., 499 to 500, 8999 to 9000, etc.).

##### 2.3 Counting

These same rules can be applied to a binary system. In this case the marks are 0 and 1. Numbers are expressed in this system by using combinations of these two marks, just as in the decimal system numbers greater than nine are expressed as combinations of the ten possible marks. By applying these three rules we can count in the binary system.

##### Decimal (Ten Marks)

##### Binary (Two Marks)

0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011
12	1100

etc.

Thus any number in the decimal system can be represented by a series of binary digits; however, since we think in quantities using the decimal system we like to convert the more unfamiliar binary system into numbers we can more readily understand.

##### 2.4 Radix

Actually we use the total number of marks in a numbering system (called the radix) raised to a power to make up numbers in the system. The radix for the decimal system is ten, since there are ten possible marks. The radix for the binary system is two since there are two possible marks. We can use the number 49 as an example. This number expressed as the radix raised to a power is:

$$49 = 4 \times 10^1 + 9 \times 10^0$$

The number  $10^1$  equals 10. The number  $10^0$  equals 1 since any number raised to the 0 power equals 1.





As another example let us express the number 2031 as the radix raised to a power:

$$2031 = 2 \times 10^3 + 0 \times 10^2 + 3 \times 10^1 + 1 \times 10^0$$

$$\begin{array}{rcl} 2 \times 10^3 & = & 2 \times 10 \times 10 \times 10 = 2000 \\ 0 \times 10^2 & = & 0 \times 10 \times 10 = 0 \\ 3 \times 10^1 & = & 3 \times 10 = 30 \\ 1 \times 10^0 & = & 1 \times 1 = 1 \\ \hline & & 2031 \end{array}$$

As a final example let us express the number 63.42 as the radix raised to a power:

$$63.42 = 6 \times 10^1 + 3 \times 10^0 + 4 \times 10^{-1} + 2 \times 10^{-2}$$

$$\begin{array}{rcl} 6 \times 10^1 & = & 6 \times 10 = 60.00 \\ 3 \times 10^0 & = & 3 \times 1 = 3.00 \\ 4 \times 10^{-1} & = & 4 \times \frac{1}{10} = \frac{4}{10} = 0.40 \\ 2 \times 10^{-2} & = & 2 \times \frac{1}{10} \times \frac{1}{10} = \frac{2}{100} = 0.02 \\ \hline & & 63.42 \end{array}$$

In other words ten is raised to one higher positive power each time we move one place to the left of the decimal, starting with  $10^0$ . Similarly ten appears to one higher negative power each time we move one place to the right of the decimal, starting with  $10^{-1}$ .

In the binary system the radix is two, so numbers are expressed as powers of two when conversion from the binary system to the decimal system is required.

For example let us convert the binary number 1101 to its decimal equivalent:

$$1101 = 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

$$\begin{array}{rcl} 1 \times 2^3 & = & 1 \times 2 \times 2 \times 2 = 8 \\ 1 \times 2^2 & = & 1 \times 2 \times 2 = 4 \\ 0 \times 2^1 & = & 0 \times 2 = 0 \\ 1 \times 2^0 & = & 1 \times 1 = 1 \\ \hline & & 13 \end{array}$$

Thus the binary number 1101 equals the decimal number 13.

As another example let us convert the binary number 111.101 to its decimal equivalent.

$$111.101 = 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$$

$$\begin{array}{rcl} 1 \times 2^2 & = & 1 \times 2 \times 2 = 4.000 \\ 1 \times 2^1 & = & 1 \times 2 = 2.000 \\ 1 \times 2^0 & = & 1 \times 1 = 1.000 \\ 1 \times 2^{-1} & = & 1 \times \frac{1}{2} = 0.500 \\ 0 \times 2^{-2} & = & 0 \times \frac{1}{4} = 0.000 \\ 1 \times 2^{-3} & = & 1 \times \frac{1}{8} = 0.125 \\ \hline & & 7.625 \end{array}$$

Thus the binary number 111.101 equals the decimal number 7.625.

## 2.5 Addition

Binary numbers can be added, subtracted, multiplied and divided by following a few simple rules.

Binary numbers can be added by following rules 2 and 3. Thus:

$$\begin{array}{rcl} 0 + 0 & = & 0 \\ 0 + 1 & = & 1 \\ 1 + 0 & = & 1 \\ 1 + 1 & = & 10 \end{array}$$

For example let us add 11 to 101:

$$\begin{array}{r} \text{Carry } 111 \\ 11 \\ + 101 \\ \hline 1000 = 8 \end{array}$$

As another example let us add 1001.110 to 111.101:

$$\begin{array}{r} \text{Carry } 11111 \\ 1001.110 \\ + 111.101 \\ \hline 10001.011 = 17.375 \end{array}$$

As a final example let us add a column of binary numbers:

$$\begin{array}{r} 11 \\ \text{Carry } 11111 \\ 1101 = 13 \\ 1011 = 11 \\ 101 = 5 \\ 1110 = 14 \\ 101011 = 43 \end{array}$$

## 2.6 Subtraction

Binary numbers can be subtracted by using the following rules:

$$\begin{array}{rcl} 0 - 0 & = & 0 \\ 0 - 1 & = & 1 \\ 1 - 0 & = & 1 \\ 1 - 1 & = & 0 \end{array}$$

Carry (To the bottom of the next left hand column)

Before we do any examples in binary subtraction let us do some examples in decimal subtraction, applying the rules we will apply to binary subtraction.

$$\begin{array}{r} 123 \\ - 78 \\ \hline 45 \end{array}$$

Since we cannot subtract 8 from 3 we change the 3 to 13 and add 1 to the 7 making it 8. Our subtraction thus becomes:

$$\begin{array}{r} 12 \quad 13 \\ - 8 \quad 8 \\ \hline 4 \quad 5 \end{array}$$

As another example:

$$\begin{array}{r} 7326 \\ - 2597 \\ \hline 4729 \end{array}$$

Since we cannot subtract 7 from 6 we change the 6 to 16 and add 1 to the 9 making it 10. We replace the 9 with a 0 however, and carry the 1. We add the 1 to the 5 making it 6. Since we cannot subtract 6 from 3 we change the 3 to 13 and add 1 to the 2 making it 3. Our subtraction thus becomes:

$$\begin{array}{r} 7 \quad 13 \quad 2 \quad 16 \\ - 3 \quad 6 \quad 0 \quad 7 \\ \hline 4 \quad 7 \quad 2 \quad 9 \end{array}$$

$$1 \times \frac{2}{1}$$

$$1 \times \frac{2}{1} \quad \frac{12}{8}$$





If we apply these very same rules to binary subtraction we should encounter a minimum of difficulty.

$$\begin{array}{r} 1101 \\ 11 \\ \hline 1010 \end{array}$$

In the first column  $1 - 1 = 0$ . In the second column  $0 - 1 = 1$  but we have to add 1 to the 0 in the bottom of the third column. This makes the bottom of the third column  $0 + 1 = 1$ . The third column subtraction is thus  $1 - 1 = 0$ . The fourth column subtraction is  $1 - 0 = 1$ . In steps this is how the example is done:

$$\begin{array}{r} 1101 \\ 111 \\ \hline 1010 \end{array}$$

As another example let us do the following:

$$\begin{array}{r} 1101 = 13 \\ - 111 = 7 \\ \hline 110 = 6 \end{array}$$

In the first column to the right  $1 - 1 = 0$ . In the second column  $0 - 1 = 1$  but we have to add 1 to the 1 in the bottom of the third column. \*This makes the bottom of the third column  $1 + 1 = 10$ . We write down the 0 and carry the 1 to the bottom of the fourth column. The third column subtraction is thus  $1 - 0 = 1$ . The fourth column subtraction is  $1 - 1 = 0$ . In steps this is how the example is done:

$$\begin{array}{r} 1101 \\ - 111 \\ \hline 0110 \end{array}$$

As a final example let us subtract 10011.101 from 101001.011:

$$\begin{array}{r} 101001.011 \\ - 10011.101 \\ \hline 10101.110 \end{array}$$

In steps this is how the example is done:

$$\begin{array}{r} 101001.011 \\ - 11110101 \\ \hline 10101.110 \end{array}$$

## 2.7 Multiplication

Binary multiplication is simple compared to decimal multiplication since there are no carries. The rules of binary multiplication are:

$$\begin{array}{l} 0 \times 0 = 0 \\ 0 \times 1 = 0 \\ 1 \times 0 = 0 \\ 1 \times 1 = 1 \end{array}$$

An example of binary multiplication is:

$$\begin{array}{r} 11001.11 \\ \times 101.01 \\ \hline 1100111 \\ 0000000 \\ 1100111 \\ 0000000 \\ 1100111 \\ \hline 100001110011 \end{array}$$

## 2.8 Division

Binary division just as decimal division is based on approximation. An example of binary division is:

$$\begin{array}{r} 10110 \\ 11001 \overline{) 1000100110} \\ \underline{11001} \phantom{00} \\ 00100101 \phantom{0} \\ \underline{11001} \phantom{00} \\ 0011001 \phantom{0} \\ \underline{011001} \phantom{0} \\ 000000 \phantom{0} \end{array}$$

The rules that have been applied for binary division are:

$$\begin{array}{l} 0 + 1 = 0 \\ 1 + 1 = 1 \end{array}$$

## 2.9 Conversion

We have already shown how we convert a binary number to its decimal equivalent. We will now show how we convert a decimal number to its binary equivalent. Suppose we want to convert the number 13 to binary form. The following procedure is used:

$$\begin{array}{r} \text{Remainder} \\ 2 \overline{) 13} \quad 1 \\ 2 \quad 6 \quad 0 \\ 2 \quad 3 \quad 1 \\ 1 \end{array}$$

We read this from the bottom to the top

Thus  $13 = 1101$  in binary form.

We accomplished this conversion by successive divisions of 2 into first the original number, and then into the quotients obtained, until the quotient was less than the radix (2). The remainder of course, if there is one, has to be 1.

As a final example let us convert the number 236.875 to binary form. The first part is the same as before:

$$\begin{array}{r} \text{Remainder} \\ 2 \overline{) 236} \quad 0 \\ 2 \quad 118 \quad 0 \\ 2 \quad 59 \quad 1 \\ 2 \quad 29 \quad 1 \\ 2 \quad 14 \quad 0 \\ 2 \quad 7 \quad 1 \\ 2 \quad 3 \quad 1 \\ 1 \end{array}$$

Therefore  $236 = 11101100$  in binary form.

The conversion of 0.875 requires a different method. We multiply 0.875 by 2. Then we multiply that portion of the result of this multiplication to the right of the decimal by 2. Each time a 1 is present to the left of the decimal after the multiplication we mark down a 1 for our binary number. We continue the multiplication until there is no remainder to the right of the decimal. Some decimals cannot be converted exactly into binary notation. Only an approximation can be made; the greater the amount of multiplications we make the better the approximation will be. We will convert 0.875 to binary form in steps:



Binary Number

$$\begin{array}{l}
 0.875 \times 2 = 1.750 \quad 0.1 \\
 0.750 \times 2 = 1.500 \quad 0.11 \\
 0.500 \times 2 = 1.000 \quad 0.111
 \end{array}$$

Thus 0.875 = 0.111 in binary notation.

Therefore 236.875 = 11101100.111.

As a final example let us convert 0.2 to binary form:

Binary Number

$$\begin{array}{l}
 0.2 \times 2 = 0.4 \quad 0.0 \\
 0.4 \times 2 = 0.8 \quad 0.00 \\
 0.8 \times 2 = 1.6 \quad 0.001 \\
 0.6 \times 2 = 1.2 \quad 0.0011 \\
 0.2 \times 2 = 0.4 \quad 0.00110
 \end{array}$$

etc.

This can go on indefinitely and it is obvious there will always be a remainder to the right of the decimal. The more steps we make the better the approximation will be.

Thus we might say 0.2 equals approximately 0.00110 in binary form.

Issued by

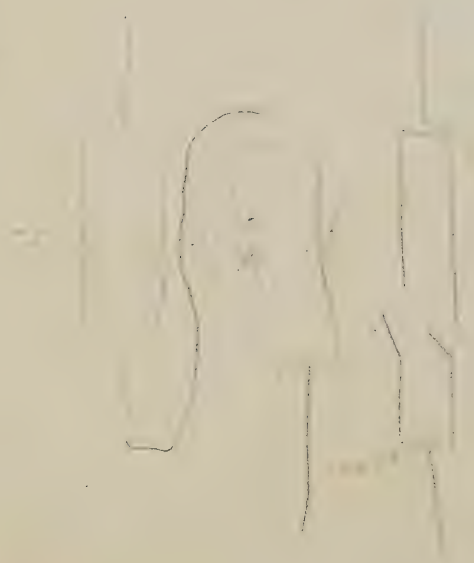
Engineer of Installation

- - -

First Edition

First Printing June 1960







# The American Radio Relay League, Inc.

WEST HARTFORD, CONNECTICUT, U. S. A.



## Certificate of Proficiency

IN RECEPTION OF THE CONTINENTAL CODE

This is to certify that E. H. MORIN, JR. W9CEY

NAME

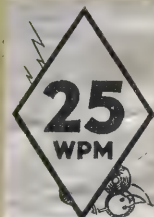
CALL

has this date qualified for this Proficiency Certificate Award, granted in recognition of skill in the basic art of the true amateur, reception by ear of the International Morse or Continental Code. By this certification and any appended endorsements to show additional qualifications, the A. R. R. L. COMMUNICATIONS DEPARTMENT expresses its recognition of merit and progress in Code Proficiency.

ABSOLUTE ACCURACY in his performance at 15 words per minute is hereby certified and acknowledged. Our examination of copy submitted as his work in copying by ear, indicates reception for a period of at least one minute of plain language, automatic tape-sent-text, averaging 5-or-more characters for each word.

Aug. 5, 1940

Date of A. R. R. L.  
Transmission from W1AW



8-30-40



JUL 20 1941

*F. E. Handy*  
Communications Manager, A. R. R. L.





2<sup>nd</sup>

This is to certify that station

W9CEY

Has duly tied for second place with W9NIL in the first annual 80 meter D.X. contest for the year 1940, which lasted from December 23 to January 6, with a total of 202 points; that is 152 points plus an added bonus of 50 points for operating with a power under 50 Watts.

Signed: Robert J. Milos  
Robert J. Milos.W

WICEY 3569 HC.

18 WATTS

152 PTS.

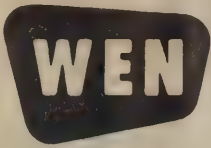
50 BONUS

202 TOTAL









# OWNER'S MANUAL MODEL 2900



## AIGUISOIR ELECTRIQUE Modèle 2900

MADE IN U.S.A. BY WEN PRODUCTS, INC., CHICAGO, IL 60631

## SAFETY RULES



### WATCH FOR ME.

Throughout this manual you will see my picture, highlighting areas of **CAUTION** and **IMPORTANCE**. If you do not heed my warning, serious injury or damage may occur.

### WARNING:

When using electric tools, basic safety precautions should always be followed to reduce the risk of fire, electric shock, and personal injury, including the following:

1. **Read all instructions.** Become fully familiar with the tool before attempting to operate it.
2. **Replacement parts.** When servicing, use only identical replacement parts.
3. **Keep work area clean.** Cluttered areas and benches invite accidents.
4. **Avoid dangerous environment.** Don't use power tools in damp, wet locations. Keep work area well lit. Do not expose to rain. Do not use tool in presence of flammable liquids or gases.
5. **Guard against electric shock.** Prevent body contact with grounded surfaces. For example; pipes, radiators, ranges, refrigerator enclosures.
6. **Keep children away.** Do not let visitors contact tool or extension cord. All visitors should be kept away from work area.
7. **Store idle tools.** When not in use, tools should be stored in dry, high or locked-up place—out of reach of children.
8. **Don't force tool.** It will do the job better and safer at the rate for which it was designed.
9. **Use right tool.** Don't force small tool or attachment to do the job of a heavy-duty tool. Don't use tool for purpose not intended—for example—don't use circular saw for cutting tree limbs or logs.
10. **Wear proper apparel.** No loose clothing or jewelry to get caught in moving parts. Rubber gloves and footwear are recommended when working outdoors. Wear protective hair covering to contain long hair.
11. **Always use safety glasses.** Also use face or dust mask if cutting operation is dusty. Everyday eyeglasses only have impact resistant lenses, they are NOT safety glasses.
12. **Don't abuse cord.** Never carry tool by cord or yank it to disconnect from receptacle. Keep cord from heat, oil and sharp edges.
13. **Secure work.** Use clamps or a vise to hold work. It's safer than using your hand and it frees both hands to operate tool.
14. **Don't overreach.** Keep proper footing and balance at all times.
15. **Maintain tools with care.** Keep tools sharp and clean for better and safer performance. Follow instructions for changing accessories. Inspect tool cords periodically and if damaged, have repaired by authorized service facility. Inspect extension cords periodically and replace if damaged. Keep handles dry, clean, and free from oil and grease.
16. **Disconnect tools.** When not in use, before servicing, & when changing accessories, such as blades, bits, cutters.

## PRECAUTIONS A PRENDRE



### FAITES ATTENTION A MOI.

Vous me verrez dans ce manuel soulignant les **PRECAUTIONS** à **PRENDRE**. Si vous ne faites pas attention à mes mises en garde, des dégâts matériels ou corporels pourraient en résulter.

### MISE EN GARDE:

Durant l'utilisation d'outils électriques. Il faut suivre les précautions d'ordre général pour diminuer les risques d'incendies, de chocs électriques et de blessures corporelles, parmi celles là:

1. **Lisez bien les instructions.** Familiarisez-vous avec votre scie avant de la mettre en marche.
2. **Pièces de rechange.** Lors d'une réparation n'utilisez que des pièces de rechange identiques.
3. **Tenez propre le lieu de travail.** Des bancs de travail encombrés favorisent les accidents.
4. **Évitez les milieux de travail dangereux.** N'utilisez pas d'outils électriques dans des lieux humides ou mouillés. Que le lieu de travail soit bien éclairé. N'exposez pas les outils à la pluie. N'utilisez pas l'outil en présence de liquides ou de gaz inflammables.
5. **Protégez-vous contre les chocs électriques.** Évitez de toucher des objets métalliques reliés à la prise de terre.
6. **Tenez les enfants à l'écart.** Ne laissez pas les visiteurs toucher les outils ou les cordons de rallonge. Tous les visiteurs doivent être tenus à l'écart du lieu de travail.
7. **Rangez les outils qui ne servent pas.** Quand ils ne servent pas, les outils doivent être rangés dans des endroits secs, à bonne hauteur ou sous clé hors d'atteinte des enfants.
8. **N'exigez pas trop de l'outil.** Il travaillera mieux et plus sûrement à la cadence qui lui est propre.
9. **Servez-vous de l'outil qui convient.** N'exigez pas d'un petit outil ou d'un petit accessoire qu'il accomplisse la tâche d'un outil plus puissant. N'utilisez pas un outil pour une tâche non recommandée. Par exemple, n'utilisez pas une scie circulaire pour couper les branches d'un arbre.
10. **Portez des vêtements appropriés.** Pas de vêtements flottants ou de bijoux qui risquent d'être happés par les pièces mobiles. Pour les travaux d'extérieur, on recommande de porter des gants et des chaussures en caoutchouc. Portez un bonnet pour y fourrer vos cheveux si vous les avez longs.
11. **Portez toujours des verres protecteurs.** Portez un masque en la présence de poussières. Des verres ordinaires ne sont pas une protection suffisante.
12. **Sachez ménager le cordon électrique.** Ne transportez jamais l'outil pa son cordon électrique et ne le débranchez jamais en tirant sur le cordon. Évitez au cordon le contact de la chaleur, de l'huile et des objets tranchants.
13. **Immobilisez fermement la pièce à travailler.** Servez-vous deattaches ou d'un étau pour bien immobiliser la pièce. C'est plus sûr que de la tenir d'une main et, ainsi, vos mains demeurent libres pour le maniement de l'outil.
14. **Ne travaillez pas en position instable.** Soyez ferme sur vos jambes et gardez l'équilibre en tout temps.
15. **Entretenez vos outils avec soin.** Gardez vos outils bien propre pour obtenir de meilleurs résultats. Pour la lubrification et le remplacement d'accessoires, suivez bien les instructions. Inspectez régulièrement le cordon électrique et éventuellement faites-le changer par une personne qualifiée. Faites de même pour les cordons électriques d'extension. Maintenez les poignées sèches, propres et libres de toute huile ou graisse.
16. **Débranchez les outils.** Quand vous ne les utilisez pas, avant toute réparation et durant le remplacement des pièces d'accessoires.



17. **Remove adjusting keys and wrenches.** Form habit of checking to see the keys and adjusting wrenches are removed from tool before turning it on.
18. **Avoid accidental starting.** Don't carry plugged-in tool with finger on switch. Be sure switch is off when plugging in.
19. **Outdoor use extension cords.** When tool is used outdoors, use only extension cords suitable for use outdoors and so marked with the suffix W-A after cord type.
20. **Stay alert.** Watch what you are doing. Use common sense. Do not operate tool when you are tired.
21. **Check damaged parts.** Before further use of the tool, a guard or other part that is damaged should be carefully checked to determine that it will operate properly and perform its intended function. Check for alignment of moving parts, binding of moving parts, breakage of parts, mounting, and any other conditions that may affect its operation. A guard or other part that is damaged should be properly repaired or replaced by an authorized service center unless otherwise indicated elsewhere in this instruction manual. Have defective switches replaced by authorized service center. Do not use tool if switch does not turn it on and off.
22. **Never leave tool running unattended. Turn power off.** Don't leave tool until it comes to a complete stop.
23. **Make workshop kid proof with padlocks,** master switches, or by removing starter keys.
24. **This tool is intended for residential use only.**
25. **Replace cracked wheel immediately.**
26. **Adjust distance between wheel and work.** Maintain 1/16-inch or less clearance as the diameter of the wheel decreases with use.
27. **Use only grinding wheels suitable for speed of grinder.**
28. **Do not over-tighten wheel nut.**
29. **Use only flanges with grinder.**
30. **Always use guards and eye shields.**
31. **Keep guards in place and in working order.**
32. **Save these instructions.**



**WARNING:**

Use of accessories not recommended with this tool may create a hazardous condition.

Any servicing requiring disassembly of the housing should be performed only by the factory.

17. **Enlevez les clés de réglage.** Prenez l'habitude de retirer les clés de réglage de l'outil avant de le mettre en marche.
18. **Gardez-vous des démarrages imprévus.** Ne transportez pas un outil branché en gardant le doigt sur la gâchette. Lors du branchement de l'appareil, veillez à ce que la gâchette ne soit pas enfoncée.
19. **Cordon de rallonge pour l'extérieur.** Lorsque l'outil doit servir à l'extérieur, n'utilisez que des cordons de rallonge destinés à cette fin et identifiés comme tels avec le suffixe W-A.
20. **Soyez vigilant.** Faites attention à ce que vous faites. Ayez le bon sens de vous arrêter quand vous êtes fatigué.
21. **Inspectez les pièces abîmées.** Avant de reprendre l'usage d'un outil, toute pièce qui paraît abîmée doit être soigneusement inspectée afin de déterminer s'il y a lieu de la réparer ou remplacer. Assurez-vous de l'alignement adéquat des pièces mobiles ainsi que de leur mouvement libre sans blocage. Une garde ou toute autre pièce abîmée doit être bien réparée ou remplacée par une personne qualifiée à moins d'indication contraire dans ce manuel. Faites remplacer les commutateurs defectueux par des personnes qualifiées. N'utilisez pas l'outil si le commutateur ne fonctionne pas proprement.
22. **Ne laissez jamais les outils fonctionnant sans votre présence.** Arrêtez-les et attendez l'arrêt complet.
23. **Ne laissez pas les enfants entrer dans l'atelier.** Fermez la porte à clé. Gardez les clés de démarrage en lieu sûr.
24. **Cet outil est destiné à usage résidentiel seulement.**
25. **Remplacez sans délai les meules fissurées.**
26. **Réglez la distance entre la meule et la pièce à travailler.** Maintenez 1/16" de séparation maximum, le diamètre de la meule s'amenuisant avec l'usage.
27. **N'utilisez que des moules se conformant à la vitesse de l'outil.**
28. **Ne serrez pas à l'excès l'écrou de la meule.**
29. **N'utilisez que des collets fournis avec la meuleuse.**
30. **Ayez toujours des gardes et utilisez de lunettes de sécurité.**
31. **Gardez les gardes en place et bonne condition de travail.**
32. **Gardez ces instructions en bonne place**



**MISE EN GARDE:**

Le recours à des accessoires non destinés à cet outil peut engendrer une situation dangereuse.

Tout réglage ou toute réparation exigeant le démontage des boîtiers ne peut se faire qu'à l'usine.

## GENERAL

### GROUND INSTRUCTIONS

In the event of a malfunction or breakdown, grounding provides a path of least resistance for electric shock. This tool is equipped with an electric cord having an equipment-grounding conductor and a grounding plug. The plug must be plugged into a matching outlet that is properly installed and grounded in accordance with all local codes and ordinances.

Do not modify the plug provided if it will not fit the outlet, have the proper outlet installed by a qualified electrician.

Improper connection of the equipment-grounding conductor can result in a risk of electric shock. The conductor with insulation having an outer surface that is green with or without yellow stripes is the equipment-grounding conductor. If repair or replacement of the electric cord or plug is necessary, do not connect the equipment-grounding conductor to a live terminal.

Check with a qualified electrician or serviceman if the grounding instructions are not completely understood, or if in doubt as to whether the tool is properly grounded.

Use only 3-wire extension cords that have 3-prong grounding plugs and 3-pole receptacles that accept the tool's plug.

Repair or replace damaged or worn cord immediately.

This tool is intended for use on a circuit that has an outlet that looks like the one illustrated in Fig. 1. The tool has a grounding plug that looks like the plug illustrated in Fig. 1. A temporary adapter, which looks like the adapter illustrated in Fig. 1, may be used to connect this plug to a 2-pole receptacle as shown in Fig. 3 if a properly grounded outlet is not available.

The temporary adapter should be used only until a properly grounded outlet can be installed by a qualified electrician. The green colored rigid ear, lug, etc. extending from the adapter must be connected to a permanent ground such as a properly grounded outlet box.

## GÉNÉRALE

### INSTRUCTIONS POUR LA PRISE DE TERRE

Dans le cas d'un mauvais fonctionnement ou d'une panne, la prise de terre présente un chemin de faible résistance pour le courant électrique. Cet outil est muni d'un cordon ayant une borne de prise de terre ainsi que d'un adaptateur de prise de terre.

Utilisez un réceptacle de courant qui est bien installée en accord avec le code électrique local.

Ne modifiez pas la prise de courant si celle-ci ne s'adapte pas au réceptacle, appelez un electricien qualifié pour l'installation d'un réceptacle adéquat.

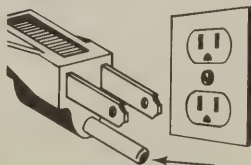
Un branchement impropre de la borne de prise de terre, peut se traduire par un risque de choc électrique. à l'intérieur du cordon le fil électrique vert avec ou sans une bande jaune est le conducteur de prise de terre, si une réparation ou un remplacement du cordon s'impose, ne reliez jamais celui-ci à l'une des bornes chaudes de la prise de courant.

Prenez l'avis d'un électricien qualifié si les explications données ne sont pas claires ou encore si vous avez des doutes concernant la qualité de la prise de terre.

Réparez ou remplacez des cordons usés ou défectueux immédiatement.

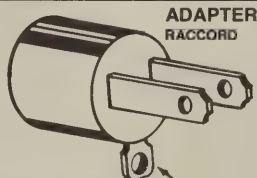
Cet outil est destiné à être branché sur un réceptacle pareil à celui de la Fig. 1. L'outil a une prise de courant pareille à celle de la Fig. 1. Un adaptateur pareil à celui de la Fig. 2 peut être utilisé temporairement pour se brancher sur un réceptacle à deux fentes pareil à celui de la Fig. 3 si un réceptacle équipé d'une borne de prise de masse intégrale n'est pas disponible.

L'adaptateur doit être utilisé temporairement jusqu'à ce qu'un réceptacle à trois bornes soit installé. De toute façon la patte métallique verte sur le côté de l'adaptateur doit être reliée à une prise de terre permanente telle que le boîtier métallique du réceptacle.



**GROUNDING BLADE**  
PLOT DE PRISE À LA MASSE

FIG. 1



**GROUND MEANS**  
PATTE DE PRISE À LA MASSE

FIG. 2

**COVER OF GROUNDED OUTLET BOX**  
COUVERCLE DE LA PRISE RELIÉE À LA MASSE

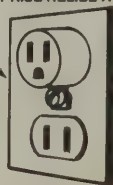


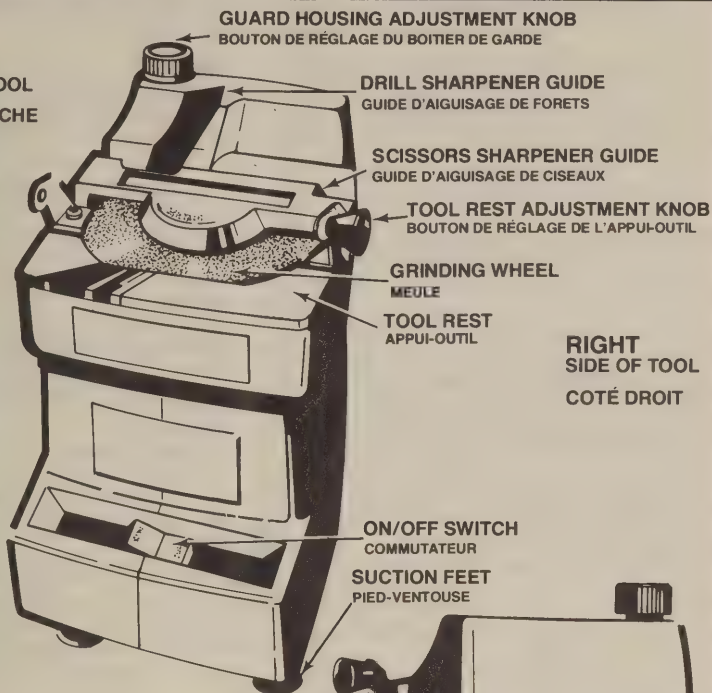
FIG. 3

## FEATURES

## CARACTÉRISTIQUES

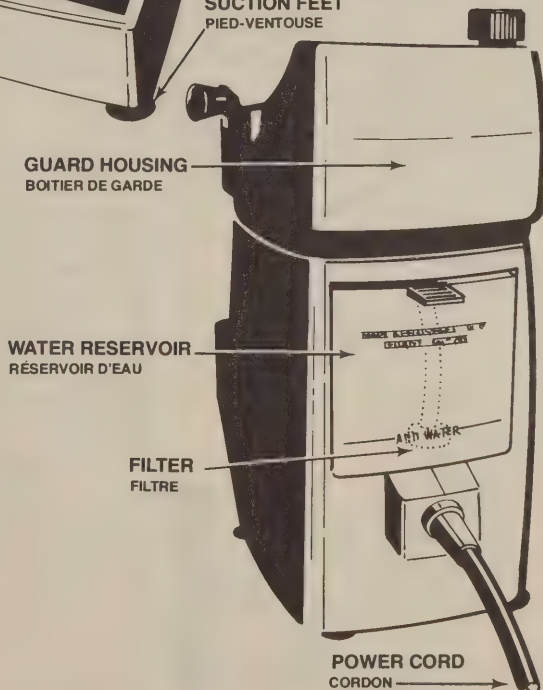
**LEFT  
SIDE OF TOOL  
COTÉ GAUCHE**

**FRONT  
FIG. 4A  
AVANT**



**RIGHT  
SIDE OF TOOL  
COTÉ DROIT**

**REAR  
FIG. 4B  
ARRIÈRE**





## ASSEMBLY & ADJUSTMENT



**CAUTION:** When making adjustments, always disconnect the grinder from its power source to avoid accidental starting.

### SUCTION FEET INSTALLATION

Fig. 5

The Wet Stone comes equipped with four suction type rubber mounting feet. Screw them into the metal inserts provided at the base as shown.

#### NOTE:

A smooth clean surface must be provided in order for the suction feet to be effective. If the tool has a tendency to tip over, slide or walk during normal operation, we recommend that the grinder be mounted as described below.

### BENCH MOUNTING:

Fig. 6 & 7

When the suction feet are impracticable or undesirable the Wet Stone may be mounted directly to a bench.

Drill (4) 3/16" dia. holes in the bench as shown in Fig. 6.

Secure by using (4) No. 8-32 machine screws (not provided) as shown in Fig. 7. Note screw length formula shown.

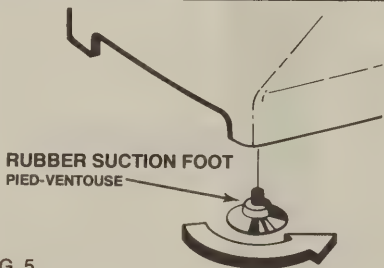


FIG. 5

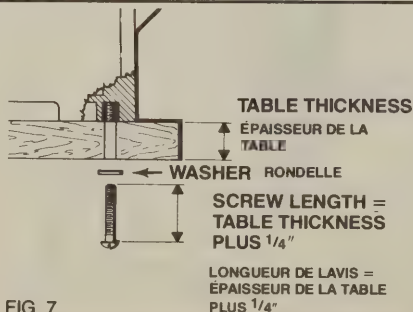


FIG. 7

## ASSEMBLAGE ET REGLAGE



**MISE EN GARDE:** Lors des réglages, débranchez l'aiguiseur afin d'évitez un démarrage accidentel.

### INSTALLATION DES PIEDS-VENTOUSE

Fig. 5

L'aiguiseur est fourni avec quatre pieds-ventouse en caoutchouc. Vissez-les dans la base comme illustré.

#### REMARQUE:

Une surface lisse et propre est indispensable pour l'efficacité des pieds-ventouse. Si l'outil a tendance à basculer, glisser ou se déplacer durant une utilisation normale, nous vous recommandons de le monter comme indiqué ci-dessous.

### MONTAGE SUR ÉTABLI:

Fig. 6 et 7

Quand l'utilisation des pieds-ventouse n'est pas pratique, l'aiguiseur peut être directement monté sur un établi.

Percez quatre trous de 3/16" de diamètre selon la Fig. 6.

Utilisez quatre vis de 8-32 (non fournies) pour le montage, la longueur des vis sera déterminée à l'aide de la formule fournie.

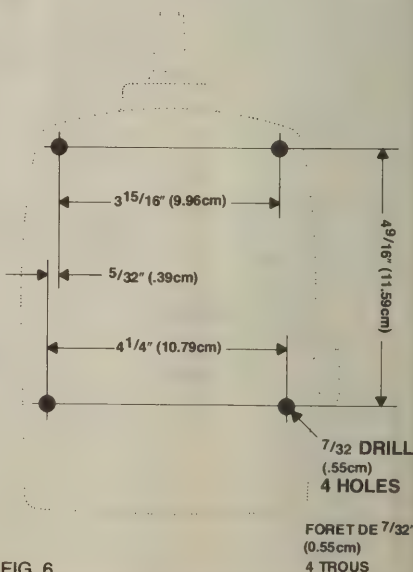


FIG. 6

## GUARD HOUSING ADJUSTMENT

Fig. 8

Raising and lowering the guard housing, in effect, increases or decreases the clearance between the tool rest and grinding wheel.

For your own safety, we recommend that you maintain 1/16" to 1/8" maximum clearance between the grinding wheel and the guard housing or tool rest at all times.

Turn the guard adjustment knob in the desired direction as noted in Figure 8. Turning the knob in the "UP" direction "INCREASES" the wheel clearance.

## TOOL REST ADJUSTMENT

Fig. 9

The tool rest is fully adjustable and has a graduated angle scale from 0° to 45°.

To adjust, loosen the lock knob located on the right side.

Move the tool rest to the desired angle by aligning the graduation and the index mark.

Securely tighten the lock knob.

For sharpening knives, or for larger grinding jobs, such as lawn mower blades, the guard may be moved completely out of the way. Always remember to securely tighten the lock knob.

## WATER RESERVOIR

Fig. 10

The Wet Stone contains it's own recirculating water system which is supplied to the grinding wheel. This allows the user to sharpen to a

## REGLAGE DU BOITIER DE GARDE

Fig. 8

Soulever ou abaisser le boîtier règle le jeu entre la meule et l'appui-outil.

Pour votre propre sécurité, nous recommandons que vous mainteniez un jeu de 1/16" à 1/8" entre la meule et l'appui-outil.

Tournez le bouton de réglage ou boîtier de garde dans la direction souhaitée selon la Fig. 8. Tourner le bouton dans la direction "UP" augmente le jeu.

## RÉGLAGE DE L'APPUI-OUTIL

Fig. 9

L'angle de l'appui-outil est complètement réglable et a une échelle graduée de 0° à 45°.

Pour régler, desserrer le bouton de calage situé à droite.

Aprenez l'appui-outil à la position désirée.

Serrez fermement le bouton de calage.

Pour l'aiguisage des couteaux ou le meulage de grosses pièces, tel que les lames des tondeuses à gazon, vous pouvez retirer complètement la garde. N'oubliez pas de bien serrer le bouton de calage.

## RÉSERVOIR D'EAU

Fig. 10

L'aiguiseur possède son propre système de circulation d'eau. Ceci permet d'obtenir des meulages meilleurs et de conserver la dureté des pièces en acier trempé.

## GUARD HOUSING ADJUSTMENT KNOB

BOUTON DE RÉGLAGE DU BOITIER DE GARDE



FIG. 8

## TOOL REST ADJUSTMENT KNOB

BOUTON DE RÉGLAGE DE L'APPUI-OUTIL

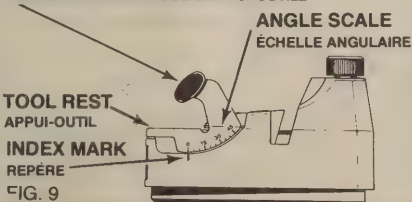
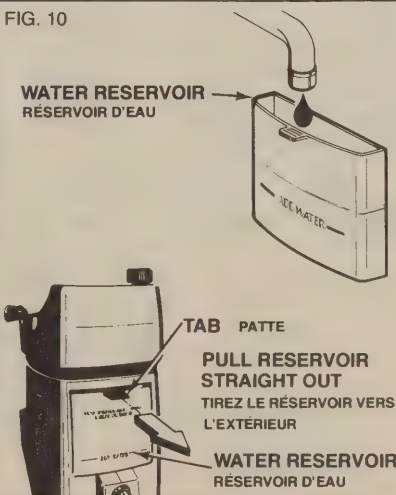


FIG. 9

FIG. 10



much finer degree' and recudes the chance of temper loss in hardened steels.

Remove the reservoir, located in the rear of the tool, by pulling straight out on the tab as shown in Fig. 10.

Fill with tap water or in areas where the water is extremely hard, use distilled water. Distilled water will reduce mineral deposits in the filter. (See MAINTENANCE-Filter).



Always maintain water level.  
Do not run the Wet Stone dry.

Pour retirer le réservoir, qui est situé à l'arrière de l'outil, tirez sur la patte selon la Figure 10.

Remplissez avec de l'eau de robinet ou si l'eau est excessivement pure, utilisez de l'eau distillée. L'eau distillée encrassera moins le filtre (Voir ENTRETIEN-Filtre).



Gardez toujours de l'eau dans le réservoir. Ne faites pas fonctionner à sec.

## OPERATING INSTRUCTIONS



Before and during the operation of your Wet Stone, a few basic, but important rules must be observed in order to insure your safety and make your job easier.

Please take time to read these along with the rest of your manual before attempting to operate your tool.

1. Always wear eye protection.
2. Keep guards in place.
3. Keep guards properly adjusted.
4. Check water supply regularly.
5. Add water when necessary. Flow from the spigot should be a smooth, steady stream as shown in Fig. 11.

## DIRECTIVES DE FONCTIONNEMENT



Avant et durant l'utilisation de votre aiguiseur, il vous faut suivre quelques règles importantes afin de rendre votre travail sur et aisé.

Lisez les directives suivantes avec le reste du manuel avant de procéder à l'aiguïsage.

1. Portez toujours des verres protecteurs.
2. Maintenez les garges en place.
3. Maintenez les gardes bien réglées.
4. Assurez-vous du niveau de l'eau.
5. Ajoutez de l'eau si nécessaire. Le jet d'eau de la canule doit être uni et constant. Voir Figure 11.

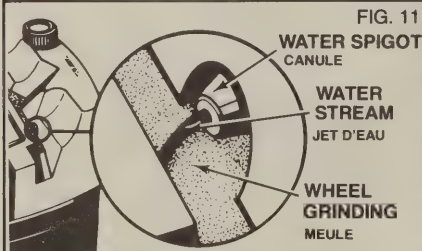


FIG. 11

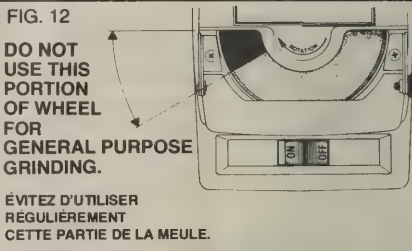


FIG. 12

HEAT BUILD UP  
PRODUCTION DE CHALEUR  
**DON'T  
MAUVAIS**

HEAT TRANSMITTED TO THE  
TIP OF WORKPIECE  
LA CHALEUR EST TRANSMISE VERS  
LA POINTE DE LA PIÈCE

GRINDING WHEEL  
MEULE

WORK PIECE  
PIÈCE

WORK PIECE  
PIÈCE

GRINDING WHEEL  
DIRECTION  
DIRECTION DE LA MEULE

**DO  
BON**

HEAT TRANSMITTED  
AWAY FROM TIP OF WORKPIECE  
LA CHALEUR EST TRANSMISE VERS  
LE CORPS DE LA PIÈCE

FIG. 13



6. Don't force – Hold the work firmly and gently ease into the grinding wheel.
7. When ever possible, use only the grinding wheel area shown in Fig. 12.
8. Work into the direction of the wheel. By doing so, any heat generated will be absorbed into the work – away from the tip. See Fig. 13.
9. Follow all maintenance instructions as noted on pages 12 & 13.
10. Follow the SHARPENING GUIDE on page 11

## SHARPENING KNIVES

Fig's 14, 15 & 16

Adjust the tool rest to it's max up position. This will fully expose the knife sharpening guide angle.

Raise the guard housing until there is approximately 1/4" clearance between the housing and grinding wheel.

Place the knife onto the guide angle and lower the guide housing until the knife edge just sparks off against the grinding wheel as shown in Fig. 15.

Draw the knife edge across the grinding wheel and rotate outward when approaching the tip as shown in Fig. 16.

Reverse the knife and sharpen the opposite edge using the same procedure.

Repeat these steps until desired sharpness is obtained.

6. Ne forcez pas. Tenez la pièce à aiguiser fermement mais sans forcer sur la meule.
7. Si possible utilisez la partie de la meule illustrée sur la Figure 12.
8. Meulez dans la direction de la deule. Ainsi toute chaleur produite sera absorbée par la masse de la pièce loin de son extrémité. Voir Figure 13.
9. Suivez des directives d'entre tien des pages 12 et 13.
10. Conformez-vous au GUIDE D'AIGUISAGE de la page 11.

## AIGUISAGE DE COUTEAUX

Figures 14, 15, 16

Réglez l'appui-outil tout vers le haut. Ceci va totalement découvrir le guide d'aiguisage de couteaux.

Soulevez le boîtier de garde jusqu'à obtenir un jeu de 1/4" entre le boîtier et la meule.

Placez le couteau sur le guide et abaissez le boîtier de garde jusqu'à ce que la lame commence à toucher la meule. Voir Figure 15.

Tirez le couteau à travers la meule en tournant vers l'extérieur quand vous approchez de la pointe. Voir Figure 16.

Retournez le couteau et faites la même chose pour aiguiser l'autre face.

Vous pouvez répéter cette procédure jusqu'à obtenir le fil désiré.



FIG. 14

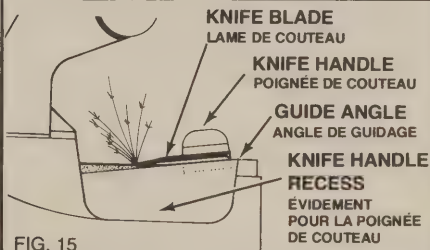


FIG. 15

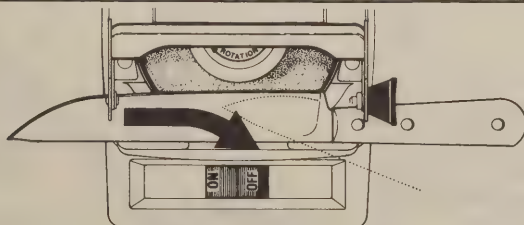


FIG. 16

## SHARPENING SCISSORS

Fig's 17 & 18

Open and place one blade of the scissors in the scissors guide slot as shown in Fig. 17.

Hold the blade firmly against the guide angle as shown in Fig. 18, and slowly draw the scissors across the grinding wheel. Repeat once or twice.

Sharpen the opposite blade using the same procedure.

## SHARPENING DRILL BITS

Fig's 19 & 20

Place the drill bit in the drill sharpening guide so that one cutting edge lightly sparks on the grinding wheel. See Fig. 20.

Holding it firmly against the guide, rotate the bit 180° in a clockwise direction. While rotating, apply heavier pressure against the wheel. The increase in pressure will give the drill bit the proper lip relief angle.

With one face angle now completed, sharpen the opposite face using exactly the same technique.

A properly sharpened bit will appear like the picture in the sharpening guide at the bottom of page 11.

Practice is very important in developing good sharpening technique.

**DRAW SCISSORS ACROSS THE WHEEL SLOWLY WHILE HOLDING FIRMLY AGAINST GUIDE FACE AS SHOWN IN FIG. 18.**

TIREZ LES CISEAUX LENTEMENT À TRAVERS LA MEULE TOUT EN PRESSANT FERMEMENT CONTRE LE GUIDE SELON LA FIG. 18.

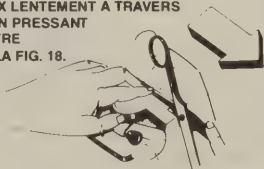


FIG. 17

## AIGUISAGE DES CISEAUX

Fig's 17 et 18

Ouvrez les ciseaux et placez, l'une des lames dans le guide conformément à la Figure 17.

Tenez la lame fermement contre le guide selon la Figure 18, et tirez lentement contre la meule. Répétez une ou deux fois.

Aiguissez de la même façon l'autre lame.

## AIGUISAGE DE FORETS

Figures 19 et 20

Placez le foret dans le guide correspondant, de façon que l'un des volutes touche légèrement la meule. Voir Figure 20.

En le tenant fermement contre le guide, tournez-le de 180° dans le sens horaire. Tout en tournant appuyez fortement contre la meule. Ceci donnera au foret la forme appropriée.

Maintenant refaites la même chose pour l'autre volute.

Un foret bien aiguisé ressemblera à celui de l'illustration au bas de la page 11.

Une longue pratique est nécessaire avant d'obtenir des forets bien aiguisés.

**HOLD SCISSORS FIRMLY AGAINST THE GUIDE ANGLE FACE.**

TENEZ LES CISEAUX FERMEMENT CONTRE LE GUIDE.

SCISSORS BLADE  
LAME DE CISEAUX

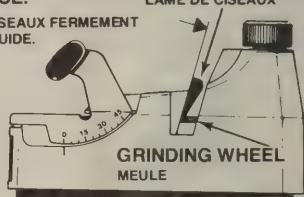


FIG. 18

SEE FIG. 20  
VOIR FIG. 20

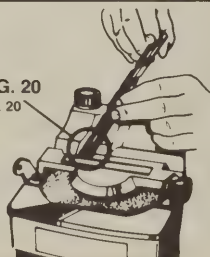
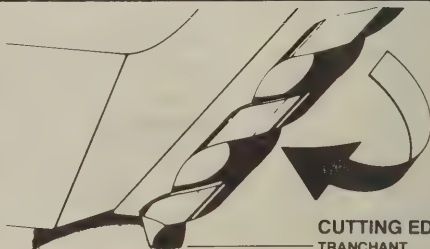


FIG. 19



CUTTING EDGE  
TRANCHANT

FIG. 20

## SHARPENING GUIDE

There are countless other tools which can be sharpened on your Wet Stone.

Below are listed some of those applications and their recommended sharpening angles.

Use this as a guide only. Certain specific tools may vary slightly.

## GUIDE D'AIGUISAGE

D'innombrables autres outils peuvent être aiguisés sur votre aiguisoir.

Vous avez ci-dessous certains de ces outils avec l'angle d'aiguisage recommandé.

Ceci est à être utilisé seulement à titre indicatif. Les caractéristiques de certains outils particuliers peuvent être différentes.

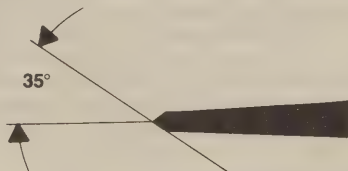
AXE

HACHE



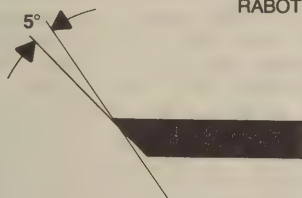
COLD CHISEL

CISEAU  
À FROID



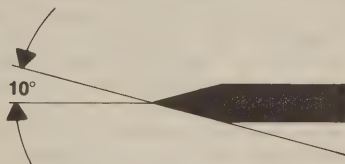
PLANER BLADE

LAME DE  
RABOT



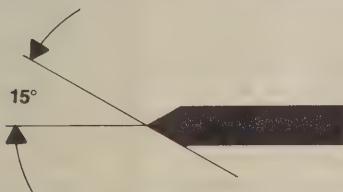
POCKET OR  
CURVING KNIFE

CANIF ET  
BURIN



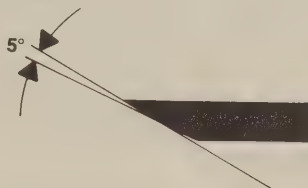
KITCHEN KNIFE

COUTEAU  
DE CUISINE



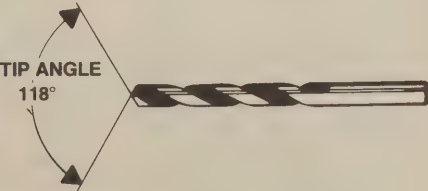
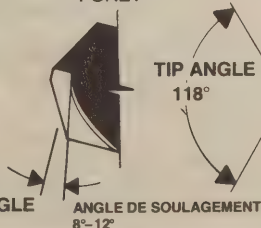
WOOD CHISEL

CISEAU



DRILL BIT

FORET





## MAINTENANCE

### CARE OF HOUSING

The housings of your Wet Stone are made of high impact plastic. When cleaning, certain chemicals such as gasoline, chlorine and ammonia must be avoided to preserve the housing finish. Mild soap and water will handle most of the clean up.

### LUBRICATION

The bearings have been packed with lubricant at the factory, and under normal use the lubricant will last almost indefinitely. However, if the grinder is in constant use or operated in an unusually dirty atmosphere, return it to the factory to have the bearings relubricated each three months to a year, depending upon conditions.

### CARE OF THE GRINDING WHEELS

In normal usage grinding wheels may become grooved, out of true, and become "loaded". Loaded simply means that soft metals or other materials have filled up the pores of the wheel. When this occurs, grinding action is greatly reduced. Grinding of soft metals such as aluminum, brass, copper, lead and the like should be avoided as much as possible. When any of the above conditions occur, the wheel may be put in good condition again by "dressing the wheel". Various tools and abrasive sticks are available in most hardware stores for this purpose. To "dress" the wheel, start the Wet Stone and work the dresser back and forth across the wheel until all grooves, etc., are gone. Be sure to use suitable eye protection for this purpose. As grinding wears away the wheel quite rapidly, it is advantageous to exercise good grinding practices which will require "dressing" of the wheel frequently.

### WHEEL REPLACEMENT/INSPECTION

Fig. 21

Turn the guard housing adjustment knob in the "UP" direction until the guard housing becomes loose. Lift the housing up and allow it to hang by the connecting water line hose. Note, it is not necessary to disconnect this hose.

Using a screwdriver to keep the output shaft from rotating, remove the nut with a wrench.

NOTE: NUT HAS A LEFT HAND THREAD.

## ENTRETIEN

### SOINS À APPORTER AU BOITIER

Les différentes parties du boîtier sont moulées dans du plastique à haute résistance à l'impact. Pour le nettoyer évitez d'utiliser des produits à base d'essence, de chlore ou d'ammoniac afin de ne pas dégrader le fini. Dans la plupart des cas de l'eau savonneuse sera suffisante.

### LUBRIFICATION

Les coussinets sont lubrifiés à l'usine et compte tenu d'un usage normal, le lubrifiant devrait durer indéfiniment. Néanmoins, si l'aiguiseur est utilisé constamment ou s'il est opéré dans un environnement poussiéreux, retournez-le à l'usine pour relubrifier les coussinets tous les trois mois ou chaque année ceci dépendant de l'usage.

### SOINS À APPORTER AUX MEULES

Normalement utilisées, les meules peuvent se rainurer, voir, leurs bords s'arrondir, se fausser et s'encrasser. Une meule s'encrasse quand des métaux mous ou d'autres matériaux en bouchent les pores. L'effet de meulage s'en trouve alors grandement diminué. Dans la mesure du possible, on devrait éviter le meulage de métaux mous tels l'aluminium, le laiton, le cuivre, le plomb, etc. Si l'on constate un des défauts susmentionnés, on peut remettre la meule en état en "dressant" la meule. On peut se procurer différents outils et bâtonnets abrasifs à cette fin dans les quincailleries. Pour "dresser" la meule, faites partir la meuleuse, appuyez l'outil à dresser sur la pièce d'apui, imprimez-lui un mouvement de va-et-vient en travers de la meule jusqu'à ce que toutes les rainures, etc. aient disparu. Dans ce cas, portez des verres de sécurité. Étant donné que le meulage use rapidement les meules, il est souhaitable d'adopter les bonnes méthodes de meulage, notamment celle de "dresser" les meules fréquemment.

### REEMPLACEMENT DE LA MEULE - INSPECTION

Figure 21

Tournez le bouton de réglage du boîtier vers "UP" jusqu'à ce que celui-ci devient lâche. Soulevez-le et laissez le tuyau d'eau branché, il n'est pas nécessaire de le débrancher.

The grinding wheel may now be removed as shown. When replacing the wheel, the nut should be torqued to approx. 8 ft/lbs. DO NOT OVERTIGHTEN.

To inspect for a damaged wheel, suspend the wheel on a piece of string and strike it lightly with the handle of a screwdriver. A good wheel will have a clear sound. A cracked wheel will have a dull "klunk" sound.

## FILTER

Fig. 22

The filter element keeps the recirculating water relatively clean. It filters out the debris suspended in water that could otherwise clog the hoses. Always keep the filter clean and when required, replace with a new one.

To remove for cleaning or replacement, grasp the hose and pull the filter until it pops out.

To clean, use an air hose or boil in water for a few minutes. Also light taping will help to dislodge trapped particles.

## DRAINS

Fig. 23

The water drains may periodically become clogged with grinding residue and require cleaning. Checking the drains is a must to insure proper water flow.

To clean, remove the guard housing by turning the guard housing adjustment knob in the UP direction until the housing becomes loose. Lift the housing up and allow it to hang by the connecting water line.

Using a wire, or alike, clean the drains of any obstructions present.

Tout en calant l'axe avec un tournevis, dévissez l'écrou au moyen d'une clé.

REMARQUE: L'ÉCROU A UN FILETAGE GAUCHE.

La meule peut maintenant être retirée comme indiqué. L'écrou doit être serré à, approximativement, 8 PIEDS × LIVRES de couple.

Ne dépassez pas cette valeur.

Pour inspecter une meule, suspendez-la à un fil et tapez-la légèrement avec un tournevis. Une bonne meule va résonner clairement. Une mauvaise va émettre un son étouffé.

## FILTRE

Figure 22

Le filtre maintient l'eau recirculante relativement propre. Elle filtre les petites particules en suspension qui autrement pourraient boucher les tubes. Maintenez toujours le filtre propre, et si nécessaire, remplacez-le.

Pour retirer le filtre, tenez le tube et tirez sur le filtre jusqu'à ce qu'il se débranche.

Pour le nettoyer, utilisez de l'air comprimé ou faites-le bouillir pour quelques minutes. Vous pouvez particules attrapées.

## CANIVEAUX

Figure 23

Les caniveaux peuvent devenir de temps en temps, obstrués par les résidus de meulage, il est alors nécessaire de les nettoyer. Inspecter les caniveaux est très important pour assurer un bon écoulement d'eau.

Pour nettoyer, retirez le boîtier de garde en tournant le bouton complètement vers "UP". Soulevez le boîtier en le laissant branché au tuyau d'eau.

À l'aide d'un fil de fer, nettoyez les caniveaux.

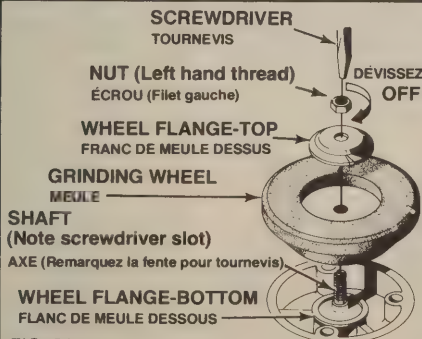


FIG. 21

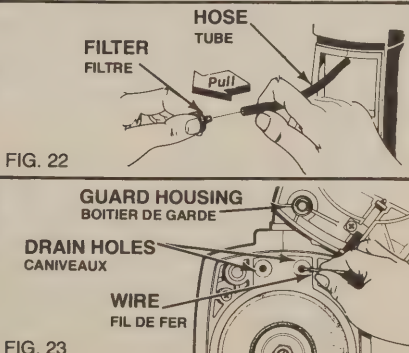


FIG. 23

## PARTS LIST

PARTS LIST			LISTE DES PIÈCES		
NO.	DESCRIPTION	PART NO./ NO. DE LA PIECE	DESCRIPTION	NO.	DESCRIPTION
1	Motor housing assembly (R.H.)	2900B33	Assemblage du boîtier du moteur (M.D.)	50	Retaining ring
2	Motor housing assembly (L.H.)	2900B34	Assemblage du boîtier du moteur (M.G.)	51	Washer
3	Center plate assembly	2900B31	Assemblage de la plaque centrale	52	Spring
4	Adjustment stud assembly	2900A58	Assemblage de la vis de réglage	53	Washer (3)
5	Guard housing assembly	2900B30	Assemblage du stator	55	Ground screw
6	Rotor assem. (120V)	2900B18	Assemblage de pompe	56	Hose clamp
7	Stator assem. (120V)	2900B29	Attache de roulement	57	Retaining ring
8	Pump assembly	2900A26	Virole de caoutchouc (4)	58	Connector
20	Bearing strap	900A205	Cordon	59	Hose
21	Grommet (4)	700A10	Attache	60	Suction feet (set of 4)
22	Line cord	2900B61	Manchon de renfort	62	Bracket assembly
23	Cord clamp	1500A34	Flanc de meule – haut	63	Knob
24	Bend relief	1500A32	Meule	64	Felt Washer
25	Wheel flange – bottom	2800A17	Roulement sphérique		
26	Wheel flange – top	2800A18	Attache de stator (4)		
27	Grinding wheel	2900B2	Réservoir		
28	Spherical bearing	2700A3	Roulement à bille		
29	Stator strap (4)	2900A11	Assemblage d'appui-outil		
30	Reservoir tank	2900B10	Châssis du moteur		
31	Ball bearing	2900A21	Manchon de scellage		
32	Bearing strap	2900A22	Filtre		
33	Tool rest assembly	2900A76	Tuyau (2)		
34	Motor frame	2900D1	Commutateur		
35	Seal sleeve	2900A19	Ecrou		
36	Filler	2900A91	Vis (3)		
38	Hose (2)	2900A90-2	Vis (9)		
41	Switch	2900A52	Vis (6)		
42	Nut	2900A39	Vis (5)		
43	Screw (3)	400A41-1	Vis (3)		
44	Screw (9)	510A48	Rondelle à ressort		
45	Screw (6)	953A17-1			
46	Screw (5)	953A17-3			
47	Screw (3)	953A17-2			
48	Spring washer	2302A35			
			<b>Optional equipment</b> Grinding wheel – 240 grit Dressing stone		
			<b>Accessories en option</b> Meule – grain 240 Pierre de lagommage		
			2900A84 2900A85		
			2900A42 2900A70 2900A55 2900A57 90A32 2900A62 41A71 2900A63 2900A90-1 2900A35 2900A77 2900A79 2900A92		
			Bague de retenue Rondelle Ressort Rondelle (3) Vis de prise de masse Attache de tuyau Bague de retenue Connecteur Tube Pied-ventouse (jeu de 4) Assemblage de bras-support Bouton Rondelle Feutre		

SEE PAGE 16 FOR ORDERING INSTRUCTIONS.

POUR COMMANDER DES PIÈCES DE RECHANGE, VOIR PAGE 16.



## ORDER FORM

### IMPORTANT

KEEP THIS FORM AND USE FOR ORDERING SERVICE REPLACEMENT PARTS, SUPPLY ITEMS OR ACCESSORIES. FILL OUT COMPLETELY AND MAIL WITH CHECK OR MONEY ORDER FOR FAST PROMPT SERVICE.

*Please fill in both TOP and BOTTOM of this Form. USE INK.*

NAME \_\_\_\_\_

STREET \_\_\_\_\_

CITY \_\_\_\_\_

STATE \_\_\_\_\_

ZIP CODE \_\_\_\_\_

PART NO.	QUANTITY	DESCRIPTION	PRICE	TOTAL

TOTAL COST OF PARTS \_\_\_\_\_

ADD YOUR LOCAL SALES TAX, IF APPLICABLE \_\_\_\_\_

ADD POSTAGE & HANDLING CHARGE \_\_\_\_\_

\$2.00

TOTAL AMOUNT DUE \_\_\_\_\_

#### INDICATE METHOD OF PAYMENT:

☐ CHECK OR MONEY ORDER ENCLOSED.

☐ PLEASE SHIP C.O.D.

☐ CHARGE TO MY MASTER CHARGE A/C # \_\_\_\_\_

EXPIRATION DATE \_\_\_\_\_

☐ CHARGE TO MY VISA CARD A/C # \_\_\_\_\_

EXPIRATION DATE \_\_\_\_\_

Please make check or money order payable to WEN PRODUCTS, INC. for total amount due.

**IMPORTANT:** Be sure to fill out the lower half of this form, print plainly and boldly with ink.  
DO NOT DETACH ANY PART OF THIS FORM

*From*

WEN PRODUCTS, INC.  
5810 Northwest Highway  
Chicago, Illinois 60631

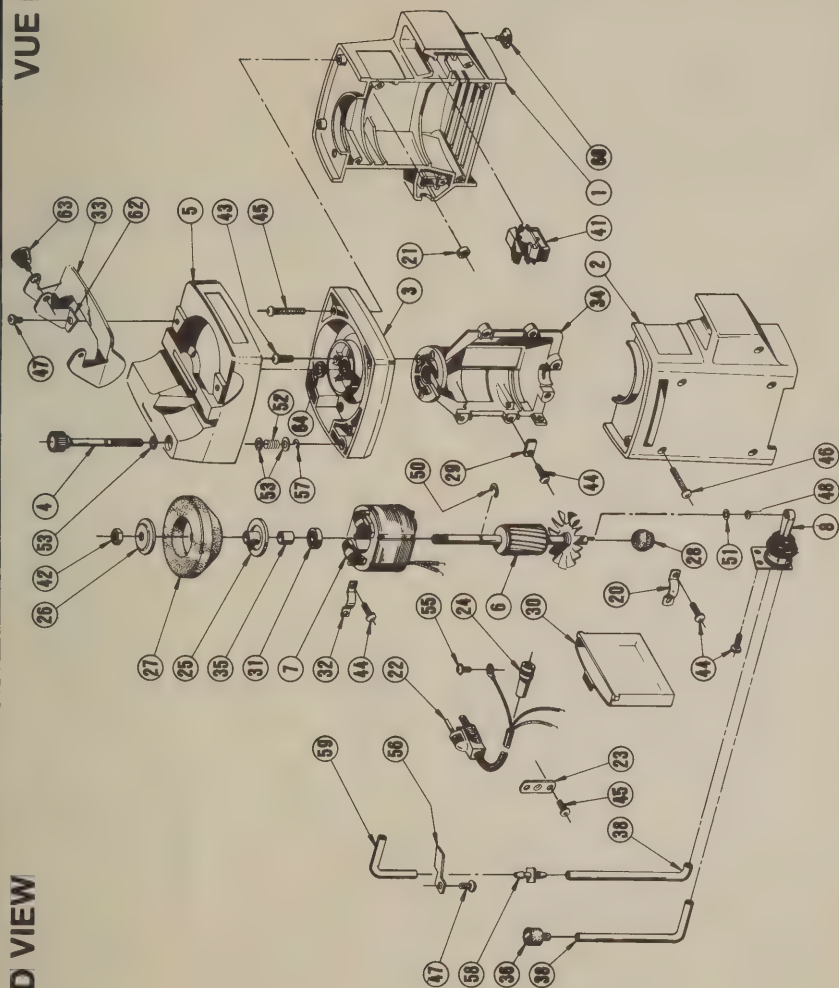
**TO**

Name \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_







This page is for your reference. On it you will find various specifications and bits of information concerning your Wet Stone. How to order replacement parts, and a space for your own personal notes.

Keep this booklet in a handy place.  
See pages 14 & 15 for the parts list.

MODEL NO. .... 2900

DATE PURCHASED .....

WHERE PURCHASED .....

DATE CODE ON TOOL .....

(6 digit no. located on bottom of tool.)

RATED AMPERAGE ..... 2.0 (120 volt)

RPM ..... 3500

NOTES:

Cette page est là à titre de référence. Vous y trouverez des informations d'ordre général concernant votre Wet Stone, les pièces de rechange, etc.

Gardez ce manuel à portée de main.

Reportez-vous aux pages 14 et 15 pour la liste des pièces de rechange.

MODELE NO. .... 2900

DATE D'ACHAT .....

LIEU D'ACHAT .....

DATE DE FABRICATION .....

(Nombre de 6 chiffres situé au bas de l'outil.)

AMPERAGE ..... 2.0 ampères à 120 volts

T/M ..... 3500

NOTES PERSONNELLES

## REPLACEMENT PARTS

Replacement parts may be ordered from the factory direct. All replacement parts ordered will be shipped C.O.D. based on prices in effect on date of shipment, or, you may request prices in advance and include your check with the order. Be sure to include Model Number, Part Number and Part Description on all orders for replacement parts.

## PIECES DE RECHANGE

On peut commander les pièces de rechange directement de l'usine. Toutes les pièces de rechange commandées seront les prix en vigueur au moment de l'expédition contre remboursement C.O.D.) selon les prix en vigueur au moment de l'expédition ou vous pouvez vous enquerir d'avance des prix et joindre votre cheque a la commande. Veillez à inscrire le numéro du modèle, le numéro de pièce et la description de la pièce dans toutes vos commandes de pièces de rechange.

### LIMITED WARRANTY

All WEN tools are thoroughly tested and checked before shipment, and are guaranteed against defective material or workmanship for a period of *one full year* from date of purchase.

Should trouble develop, return tool prepaid direct to factory. If our inspection shows that the trouble was caused by defective material or workmanship, we will repair or replace without charge and return prepaid. Repairs made necessary by normal wear, abuse or out of warranty will be charged for at our regular repair prices.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Send, inquiries and tools requiring service directly to our Service Center, WEN PRODUCTS, INC. Service Center, 5810 Northwest Hwy., Chicago, Ill. 60631.

### WEN PRODUCTS, INC.

5810 Northwest Hwy. Chicago, Illinois 60631  
(312) 763-6060 TWX 9102213025

### GARANTIE LIMITEE

Tous les outils WEN font l'objet d'un essai et d'un examen minutieux avant d'être livrés et ils bénéficient d'une garantie d'une année entière depuis la date d'achat contre toute imperfection du matériau ou tout vice de fabrication.

En cas de défectuosité, renvoyez l'outil directement à l'usine, port payé. Si notre examen révèle que la défectuosité est imputable à une imperfection du matériau ou à un vice de fabrication, nous réparons ou remplaçons l'outil sans frais et le renverrons port payé. Les réparations découlant d'une usure normale, d'un usage abusif ou ne bénéficiant plus de la garantie seront facturées en conformité avec nos prix de réparation courants.

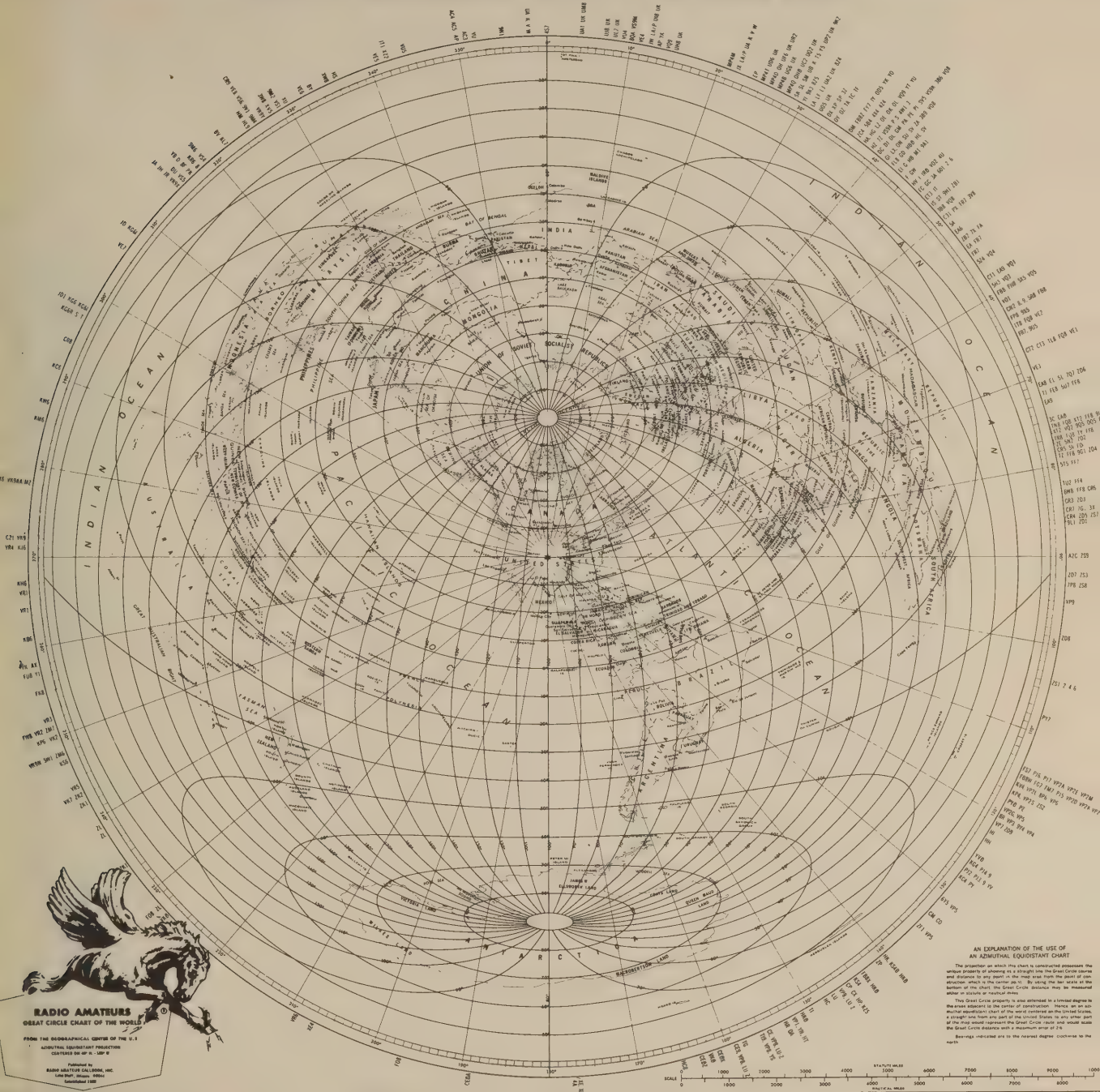
Faites parvenir vos demandes de renseignements et vos outils défectueux directement à notre Centre d'entretien et de réparation, WEN PRODUCTS, INC. Service Center, 5810 Northwest Hwy, Chicago, Ill. 60631.

### WEN PRODUCTS, INC.

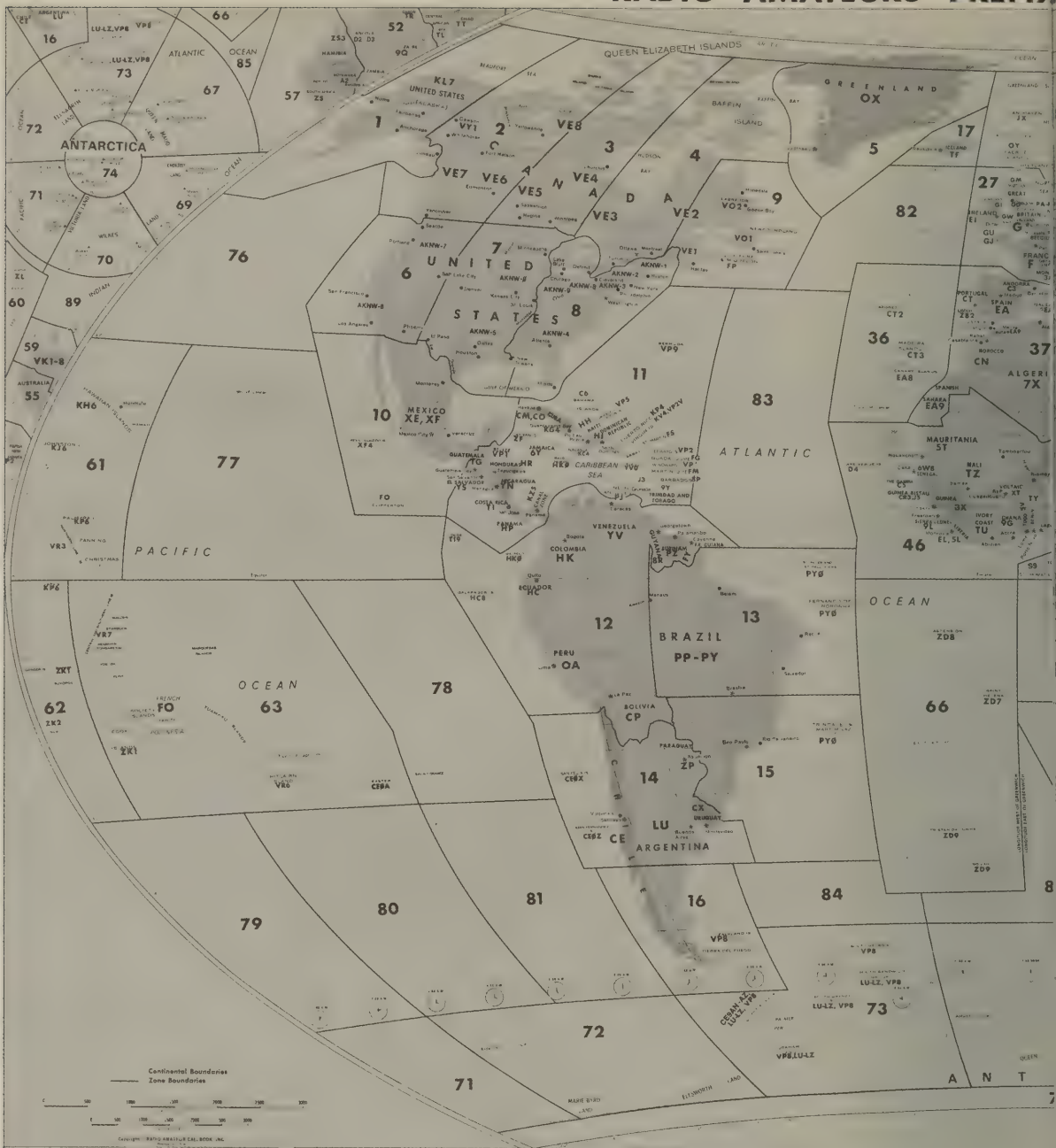
5810 Northwest Hwy. Chicago, Illinois 60631  
(312) 763-6060 TWX 9102213025

# RADIO AMATEURS GREAT CIRCLE CHART OF THE WORLD

## FROM THE GEOGRAPHICAL CENTER OF THE UNITED STATES



This map is available in four colors, 29.5" X 25".  
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## INTERNATIONAL RADIO AMATEUR PREFIXES

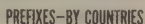
The following prefixes are listed in alphabetical order by country in the order that they are heard.

A	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AV	AW	AX	AY	AZ
B	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BV	BW	BX	BY	BZ
C	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN	CO	CP	CQ	CR	CS	CT	CV	CW	CX	CY	CZ
D	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN	DO	DP	DQ	DR	DS	DT	DV	DW	DX	DY	DZ
E	EA	EB	EC	ED	EE	EF	EG	EH	EI	EJ	EK	EL	EM	EN	EO	EP	EQ	ER	ES	ET	EV	EW	EX	EY	EZ
F	FA	FB	FC	FD	FE	FF	FG	FH	FI	FJ	FK	FL	FM	FN	FO	FP	FQ	FR	FS	FT	FV	FW	FX	FY	FZ
G	GA	GB	GC	GD	GE	GF	GG	GH	GI	GJ	GK	GL	GM	GN	GO	GP	GQ	GR	GS	GT	GV	GW	GX	GY	GZ
H	HA	HB	HC	HD	HE	HF	HG	HH	HI	HJ	HK	HL	HM	HN	HO	HP	HQ	HR	HS	HT	HV	HW	HX	HY	HZ
I	IA	IB	IC	ID	IE	IF	IG	IH	II	IJ	IK	IL	IM	IN	IO	IP	IQ	IR	IS	IT	IV	IW	IX	IY	IZ
J	JA	JB	JC	JD	JE	JF	JG	JH	JI	IJ	JK	JL	JM	JN	JO	JP	JQ	JR	JS	JT	JV	JW	JX	JY	JZ
K	KA	KB	KC	KD	KE	KF	KG	KH	KI	KJ	KK	KL	KM	KN	KO	KP	KQ	KR	KS	KT	KV	KW	KX	KY	KZ
L	LA	LB	LC	LD	LE	LF	LG	LH	LI	LJ	LK	LL	LM	LN	LO	LP	LQ	LR	LS	LT	LV	LW	LX	LY	LZ
M	MA	MB	MC	MD	ME	MF	MG	MH	MI	MJ	MK	ML	MM	MN	MO	MP	MQ	MR	MS	MT	MV	MW	MX	MY	MZ
N	NA	NB	NC	ND	NE	NF	NG	NH	NI	NJ	NK	NL	NM	NN	NO	NP	NQ	NR	NS	NT	NV	NW	NX	NY	NZ
O	OA	OB	OC	OD	OE	OF	OG	OH	OI	OJ	OK	OL	OM	ON	OO	OP	OQ	OR	OS	OT	OV	OW	OX	OY	OZ
P	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL	PM	PN	PO	PP	PQ	PR	PS	PT	PV	PW	PX	PY	PZ
Q	QA	QB	QC	QD	QE	QF	QG	QH	QI	QJ	QK	QL	QM	QN	QO	QP	QQ	QR	QS	QT	QV	QW	QX	QY	QZ
R	RA	RB	RC	RD	RE	RF	RG	RH	RI	RJ	RK	RL	RM	RN	RO	RP	RQ	RR	RS	RT	RV	RW	RX	RY	RZ
S	SA	SB	SC	SD	SE	SF	SG	SH	SI	SJ	SK	SL	SM	SN	SO	SP	SQ	SR	SS	ST	SV	SW	SX	SY	SZ
T	TA	TB	TC	TD	TE	TF	TG	TH	TI	TJ	TK	TL	TM	TN	TO	TP	TQ	TR	TS	TT	TV	TW	TX	TY	TZ
U	UA	UB	UC	UD	UE	UF	UG	UH	UI	UJ	UK	UL	UM	UN	UO	UP	UQ	UR	US	UT	UV	UW	UX	UY	UZ
V	VA	VB	VC	VD	VE	VF	VG	VH	VI	VJ	VK	VL	VM	VN	VO	VP	VQ	VR	VS	VT	VV	VW	VX	VY	VZ
W	WA	WB	WC	WD	WE	WF	WG	WH	WI	WJ	WK	WL	WM	WN	WO	WP	WQ	WR	WS	WT	WV	WW	WX	WY	WZ
X	XA	XB	XC	XD	XE	XF	YG	YH	YI	YJ	YK	YL	YM	YN	YO	YP	YQ	YR	YS	YT	YV	YW	YX	YY	YZ
Y	YA	YB	YC	YD	YE	YF	YG	YH	YI	YJ	YK	YL	YM	YN	YO	YP	YQ	YR	YS	YT	YV	YW	YX	YY	YZ
Z	ZA	ZB	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ	ZK	ZL	ZM	ZN	ZO	ZP	ZQ	ZR	ZS	ZT	ZV	ZW	ZX	ZY	ZZ



90-ZONE  
RADIO AMATEURS  
PREFIX MAP OF THE WORLD





This map is available in four colors, 40" X 28". See your dealer or write for a free Callbook catalog.

# United States

The table below shows the great circle bearing in degrees and the distance in statute miles, from the point indicated above to countries throughout the world having licensed radio amateurs.

PREFIX	COUNTRY	BEARING	MILES	PREFIX	COUNTRY	BEARING	MILES	PREFIX	COUNTRY	BEARING	MILES
A.K.N.W.	USA, San Francisco	270	1182	KC4	Navassa Is.	128	2139	VP5	Turks Is., Grand Turk	119	2182
A.K.N.W.	USA, Chicago	74	344	KC6	Caroline Is. (Ponape)	283	6535	VP5	Calcos Is., Kew	119	2068
A.K.N.W.	USA, New York	79	368	KC6	Guantanamo Bay (Cuba)	126	2034	VP5	Maui Is. (Hawaii)	119	2682
AP	Pakistan, Karachi	15	7848	KG6	Mariana Is. (Guam)	296	6898	VP8	South Georgia Is.	146	7507
AP	Botsuana, Kanye	98	4040	KH6	Kure Is.	286	3624	VP8	South Shetland Is.	146	7680
AP	Tonga, Nukunono	244	6403	KH6	Kure Is.	286	4402	VP8	South Sandwich Is.	146	7880
A4	Oman, Muscat	21	7817	KJ6	Johnston Is.	271	4421	VP8	South Shetland Is.	146	7880
A6	Bhutan, Thimbu	77	3764	KP6	Alaska, Adorap	282	3036	VP8	South Shetland Is.	146	7880
A6	United Arab Emirates, Dubai	24	7670	KM6	Midway Is.	235	4351	VP8	Chagos Is., Diego Garcia	14	10109
A7	Qatar, Doha	27	7602	KP6	Puerto Rico, San Juan	117	2541	VR1	British Indian Is.	268	6293
AV	Bahrain, Al-Manamah	79	3514	27	Palmira Is.	44	6853	VR1	Maui Is. (Hawaii)	119	2682
BE	Taiwan, Taipei	322	7222	KQ5	American Samoa, Pago Pago	247	5880	VR3	Line Is., Northern	263	4377
BY	China, Peking	233	6481	KW6	U.S. Virgin Is., Charlotte Amalie	116	2588	VR7	Phoenix Is.	268	6293
CE	Chile, Santiago	155	6368	KW8	Marshall Is. (Kwajalein)	279	5977	V85	Line Is., Central & Southern	241	4723
CEBAN-2A	South Shetland Is.	162	4408	KZ5	Canal Zone, Colon	145	2492	V87	Brunel	31	8616
CEBAN-2A	Easter Is.	189	4677	LA	Norway, Oslo	31	5057	V88	Hong Kong, Victoria	26	7625
CEB-2	San Felix Is.	151	4752	LA-AL	Buenos Aires	38	5848	VU1	India, Calcutta	352	8055
CEB-2	Juan Fernandez Is.	162	5300	LX	Luxembourg, Luxembourg	41	4778	VU1	Andaman Is., Port Blair	344	8888
CEM-2C	Cuba, Havana	133	5686	LX	Bulgaria, Sofia	38	5694	VU1	Laccadive Is., Kavaratti	9	8888
CN	Morocco, Casablanca	62	4963	M1	San Marino	43	5263	VY1	Canadian Yukon, Whitehorse	326	2035
CN	Bolivia, La Paz	146	4398	MA	Peru, Lima	153	3897	XE,XF	Mexico, Mexico City	177	1481
CN	Mexico, Mexico	177	1481	MA	Lebanon, Beirut	36	6579	XE	Vietnam, Hanoi	177	1481
CT	Portugal, Lisbon	88	4621	OD	Austria, Vienna	36	5210	XV	Vietnam, Hanoi	177	1481
CT	Azores Is., Horta	67	3985	OD	Finland, Helsinki	26	4859	XW	Laos, Vientiane	335	8503
CT	Madagascar, Fianarant	67	4173	OL	Czechoslovakia, Prague	38	5043	XW	Burma, Rangoon	342	8377
CT	Uruguay, Montevideo	145	5998	ON	Greenland, Godthab	33	2541	YA	Alghanistan, Kabul	9	7210
CT	Nauru Is.	271	4123	OL	Belgium, Brussels	41	4686	YB-YD	Faros Is., Torshavn	33	5021
C3	Andorra, Andorra	60	4928	ON	Switzerland, Bern	34	4740	YI	Iraq, Baghdad	30	6898
C5	The Gambia, Bathurst	84	5287	OX	Netherlands, Amsterdam	40	4659	YI	New Hebrides, Vila	257	7171
C5	Bahama Is., Nassau	169	5995	PJ	Curacao Is., Willemstad	127	2714	YI	Syria, Damascus	36	6868
CE-9	Mozambique, Maputo	85	4999	PJ	Aruba Is., Oranjestad	127	2714	YI	Nicaragua, Managua	152	2126
DA-OL	West Germany, Bonn	40	4770	PJ	Bonair Is., Kralendijk	216	526	YI	Rio de Janeiro, Rio de Janeiro	152	2126
DM	East Germany, Berlin	36	4874	PJ	Sint Eustatius Is.	114	2684	YI	El Salvador, San Salvador	158	1927
DM	Philippines, Manila	316	7013	PJ	Sint Maarten Is.	114	2684	YI	Yugoslavia, Belgrade	38	5491
DO-3	Angola, Luanda	62	4964	PJ	Sint Eustatius Is.	114	2684	YI	Venezuela, Caracas	127	2007
DO-3	Cape Verde, Praia	86	4886	PJ	Sint Eustatius Is.	114	2684	YI	Albania, Tirana	41	5686
DO-3	State of Camero, Maroua	90	4641	PJ	Sint Eustatius Is.	114	2684	YI	Manchili Is., Port Louis	107	1919
EA	Spain, Madrid	84	4001	PJ	Sint Eustatius Is.	114	2684	YI	Sint Helena Is.	92	7776
EA6	Baleares Is., Palma de Mallorca	81	4095	PJ-PV	Brazil, Brasilia	126	5125	YI	Sint Helena Is.	92	7776
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Fernando de Noronha Is.	118	6223	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Trindade & Martin Vaz Is.	118	6223	ZK2	Rio de Janeiro, Rio de Janeiro	152	2126
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Sunman, Paramaribo	118	6654	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
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EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port Moresby	28	7878	ZK2	Ascension Is.	99	6376
EA6	Canary Is. (Gran Canaria)	71	5765	PV	Papa New Guinea, Port						



# CHICAGO, ILLINOIS

27

The table below shows the great circle bearing in degrees and the distance in statute miles, from the point indicated above to countries throughout the world having licensed radio amateurs.

PREFIX	COUNTRY	BEARING	MILES	PREFIX	COUNTRY	BEARING	MILES	PREFIX	COUNTRY	BEARING	MILES
A.K.N.W.	USA, San Francisco.	273	1831	KC4	Nevada Is.	152	1813	VP5	Turks Is., Grand Turk	141	1739
A.K.N.W.	USA, Chicago	0	0	KC6	Caroline Is. (Ponape)	282	7120	VP8	Caicos Is., Kew	142	1847
A.K.N.W.	USA, New York	91	707	KGB	Guantanamo Bay (Cuba)	180	1885	VP8	Falkland Is., Stanley	152	6733
A2	Pakistan, Karachi	76	7502	KGB	Mariana Is. (Guam)	306	7383	VP8	South Georgia Is.	152	7278
A2	Botswana, Kanye	96	8493	KH6	Hawaii, Honolulu	274	4275	VP8	South Orkney Is.	160	7510
A3	Tonga, Nukunono	252	7055	KH6	Kure Is.	292	4980	VP8	South Sandwich Is.	150	7339
A5	Omari, Muscat	32	7416	KJ6	Johnston Is.	275	5062	VP8	South Shetland Is.	167	7350
A5	Bhutan, Thimbu	2	7682	KL7	Alaska, Anchorage	319	2857	VP9	Bermuda Is., Hamilton	112	1418
A5	United Arab Emirates, Dubai	38	7242	KL7	Midway Is.	291	4933	VO9	Chagos Is., Diego Garcia	33	9332
A7	Qatar, Doha	37	7151	KP4	Puerto Rico, San Juan	136	2087	VR1	British Phoenix Is.	274	6945
A9	Bahrain, Al-Manamah	37	7080	KP6	Palmyra Is.	284	5146	VR1	Gilbert Is., Tarawa	277	6662
BV	Taiwan, Taipei	333	7475	KV4	U.S. Virgin Is., Charlotte Amalie	134	2123	VR6	Pitcairn Is.	219	5363
BY	China, Peking	342	6595	KW5	Wake Is.	294	8104	VR7	Line Is., Central & Southern	250	5368
CE	Chile, Santiago	186	5287	KX5	Marshall Is. (Kwajalein)	287	6586	VU	Laccadive Is., Kavaratti	23	6589
CEBAN-AX	South Shetland Is.	167	7350	KZ5	Canal Zone, Colon	166	2322	VU6	Hong Kong, Victoria	338	7819
CEB-X	Easter Is.	200	4858	LA-LJ	Norway, Oslo	35	4045	VU7	Andaman Is., Port Blair	359	8791
CEB-Z	San Felix Is.	173	4722	LA-LJ	Argentina, Buenos Aires	156	5640	VU7	Nicarag. Is., Banague	358	9087
CEB-Z	Juan Fernandez Is.	173	5278	LX	Luxembourg, Luxembourg	47	4234	VU7	Laccadive Is., Kavaratti	23	6589
CM.CO	Cuba, Havana	164	1347	LZ	Bulgaria, Sofia	45	5167	VY1	Canadian Yukon, Whitehorse	320	2357
CN	Morocco, Casablanca	68	4219	M1	San Marino	50	4703	XE.XF	Mexico, Mexico City	206	1720
CP	Bolivia, La Paz	158	4196	OA	Peru, Lima	167	3789	XF4	Revilla Giedgo Is.	228	2097
CR9	Macao	338	7819	OB	Lebanon, Beirut	44	6083	XU	Vietnam, Hanoi	346	8014
CT2	Portugal, Lisbon	64	3990	OE	Austria, Vienna	45	4884	XV	Laos, Vientiane	348	7552
CT2	Atores Is., Horta	73	3030	OF	Finland, Helsinki	31	4440	XV	Burma, Rangoon	356	8370
CT3	Madeira Is., Funchal	75	3816	OK	Czechoslovakia, Prague	44	4628	XV	Afghanistan, Kabul	19	6929
CU	Uruguay, Montevideo	154	5684	OK.OL	Belgium, Brussels	47	4123	YB-YD	Indonesia, Jakarta	336	9810
C2	Nauru, Yaren	280	7261	ON	Greenland, Godthab	31	4079	YK	New Hebrides, Vila	266	7781
C3	Andorra, Andorra	57	4329	ON	Belgium, Brussels	47	4123	YK	Syria, Damascus	44	6153
C3	The Gambia, Bathurst	93	5533	ON	Greenland, Godthab	31	4079	YK	Nicaragua, Managua	347	8225
C6	Bahama Is., Nassau	149	3137	OY	Faeroe Is., Torshavn	37	3439	YV	Romania, Bucharest	43	5226
CB.C9	Morambique, Maputo	92	8943	OZ	Denmark, Copenhagen	39	4254	YV	El Salvador, San Salvador	183	1923
DA.DL	West Germany, Bonn	46	4235	PA.PI	Netherlands, Amsterdam	45	4125	YV	Yugoslavia, Belgrade	129	1563
DM	East Germany, Berlin	42	4371	PJ	Curacao Is., Willemstad	145	2893	YV	Venezuela, Caracas	145	2536
DM	Philippines, Manila	82	6112	PJ	Ange Is., Kralendijk	145	2893	ZA	Albania, Tirana	48	5149
DD.D3	Angola, Luanda	90	7185	PJ	Bonaire Is., Kralendijk	145	2893	ZB	Gibraltar	65	4286
DE	Cape Verde, Praia	96	6236	PJ	Sint Eustatius Is.	131	2199	ZB	St. Helena Is.	107	2141
DE	State of Comoro, Moroni	70	8839	PJ	Saba Is.	131	2199	ZB	Ascension Is.	107	5768
E6	Spain, Madrid	61	4183	PJ	Sint Maarten Is.	131	2199	ZB	Rhodesia, Salisbury	85	8511
E6A	Balearic Is., Palma de Mallorca	58	4493	PJ.P.Y	Brazil, Brasilia	139	1735	ZB	Cayman Is., Georgetown	184	1631
E6A	Canary Is. (Gran Canaria)	78	4104	PY6	Fernando de Noronha Is.	117	4711	ZB	Cook Is. (Rarotonga)	243	6341
E6A	Cuba, Havana	164	1347	PY6	Trinidad & Martin Vaz Is.	127	5138	ZK1	Manahiki Is.	251	5806
E6A	Malilla	85	4418	P2	Surinam, Paramaribo	132	3189	ZK2	Niue Is., Alofi	251	5806
EL.5L	Ireland, Dublin	48	3681	P2	Papua New Guinea, Port Moresby	287	8489	ZK2	New Zealand, Auckland	244	8203
EP	Iran, Tehran	33	6520	SI-SM	Sweden, Stockholm	34	4289	ZL	Auckland Is.	232	8995
ET	Ethiopia, Addis Ababa	57	7574	SP	Poland, Warsaw	39	4680	ZL	Chatham Is.	234	8112
F	France, Paris	50	4416	SP	Sudan, Khartoum	57	6943	ZL	Kermadec Is.	247	7594
F.B2W	Grozet Is.	112	10441	SP	Egypt, Cairo	50	6125	ZL	Tokelau Is.	267	7401
F.B2W	Kerguelen Is.	121	11220	SV	Greece, Athens	48	5447	ZP	Paraguay, Asuncion	152	5000
F.B2	Amsterdam & St. Paul Is.	75	11642	SV5	Greece, Athens	48	5447	ZP	South Africa, Capetown	109	9483
F.B2	Cortica Is.	47	5166	SZ.S3	Sudan, Khartoum	57	6943	ZP	Prince Edward & Marion Is.	117	9786
F.B2	Guaadelupe, Basse Terre	132	2350	S8	Trankee, Umtata	101	8960	ZP.ZS3	Namibia, Windhoek	99	8003
F.B2	Mayotte Is.	69	4276	S9	St. Thomas & Principe	87	6462	3A	Monaco	52	4503
FM	New Caledonia, Noumea	263	8053	TA-TC	Turkey, Ankara	42	5673	3A	Agalete Is.	55	5374
FO	Martinique, Fort-de-France	132	2445	TA-TC	Turkey, Ankara	42	5673	3A	Mauritius Is., Port Louis	58	5979
FO	French Polynesia (Paititi)	132	2445	TA-TC	Turkey, Ankara	42	5673	3A	Rodriguez Is.	58	10181
FO	Clipperton Is.	217	2561	TG	Guatemala, Guatemala City	185	1866	3C	Equatorial Guinea, Bata	83	6523
FO	St. Pierre & Miquelon Is.	86	1588	TG	Costa Rica, San Jose	173	2217	3C	Chad Is., N'djamena	259	7221
FR	Glorioso Is.	86	1588	TJ	Congo, Brazzaville	78	8884	3D	Swaziland, Mbabane	93	8840
FR	Juan de Nova Is.	75	9074	TJ	Congo, Brazzaville	78	8884	3V	Guinea, Conakry	93	4922
FR	Reunion Is., Saint-Denis	63	9555	TR	Gabon, Libreville	86	6565	3Y	Bouvet Is.	135	8509
FR	Tomelin Is.	63	9555	TR	Congo, Brazzaville	78	8884	4S	Sri Lanka, Colombo	16	8978
FR	Saint Martin Is.	131	2199	TR	Ivory Coast, Abidjan	91	8655	4S	United Nations, Geneva	51	4385
FR	Wallis & Futuna Is.	259	6538	TR	Benin, Porto-Novo	85	5979	4W	Yemen, San'a	47	7451
FW	French Guiana, Cayenne	129	3363	T2	Mali, Bamako	87	5086	4X.4Z	Israel, Tel Aviv	46	6171
G	England, London	46	3971	T2	Tuvalu Is.	272	6888	5A	Libya, Tripoli	58	5228
GD	Isle of Man, Douglas	46	3729	UA1	European U.S.S.R., Moscow	29	4970	5B.2C	Cyprus, Nicosia	45	5937
GI	Northern Ireland, Belfast	46	3628	UA1	Astute U.S.S.R., Irkutsk	353	5918	5B.2C	Zanzibar, Koni	68	8352
GJ	Jersey, St. Helier	51	3968	UA1	White Russian S.S.R., Minsk	34	4803	5H3	Tanzania, Dar-Es-Salaam	69	8401
GM	Scotland, Glasgow	44	3675	UC2	Azerbaijan S.S.R., Baku	31	6193	5H3	Nigeria, Lagos	55	5979
GW	Wales, Cardiff	49	3855	UC6	Georgian S.S.R., Tbilisi	33	6938	5H3	Malagasy Republic, Tananarive	72	8412
HA.HG	Hungary, Budapest	44	4836	UF6	Georgian S.S.R., Tbilisi	33	6938	5N	Mauritania, Nouakchott	88	4485
H8	Switzerland, Bern	49	4386	UG6	Turkmen S.S.R., Ashgabad	27	6514	5U	Niger, Niamey	80	5582
H8	Liechtenstein, Vaduz	48	4502	UH6	Uzbek S.S.R., Tashkent	17	5532	5U	Togo, Lome	88	5877
HC	Ecuador, Quito	186	2960	UJ8	Tadzhik S.S.R., Dushanbe	18	6684	5V	Western Samoa, Apia	256	5587
HC8	Galapagos Is.	184	2902	UL2	Kazakh S.S.R., Karaganda	12	5986	6X	Uganda, Kampala	68	8006
HJ1	Haiti, Port-au-Prince	145	1830	UM8	Kirghiz S.S.R., Frunze	13	6479	6X	Kenya, Nairobi	68	8006
HJ1	Dominican Rep., Santo Domingo	143	1952	UO5	Moldavian S.S.R., Kishinov	39	5178	6X	Somali Rep., Mogadishu	57	8210
HK	Colombia, Bogota	159	2753	UO2	Lithuanian S.S.R., Vilnius	35	4668	6W	Senegal, Dakar	91	4544
HK8	San Andres & Providencia Is.	167	2038	UR2	Estonian S.S.R., Tallinn	32	4485	6W	Jamaica, Kingston	156	1788
HL.HM	Korea, Seoul	333	6509	VE1	Canada, Nova Scotia, Halifax	72	1200	70	South Yemen, Aden	50	7603
HP	Panama, Panama	186	2322	VE2	Canada, Quebec, Montreal	63	733	70	Lesotho, Maseru	89	8750
HR	Honduras, Tegucigalpa	179	1930	VE3	Canada, Ontario, Toronto	69	459	70	Mali, Bamako	80	8627
HV	Thailand, Bangkok	350	8545	VE4	Canada, Manitoba, Winnipeg	324	719	7X	Algeria, Algiers	60	4613
HV	Vietnam City, Hanoi	347	7819	VE6	Canada, Saskatchewan, Saskatoon	314	1431	8P	Barbados Is., Bridgetown	132	2597
HZ.7Z	Saudi Arabia, Riyadh	41	6889	VE7	Canada, British Columbia, Vancouver	298	1769	8Q	Maldives Is., Male	25	9071
I	Solomon Is. (Guadalcanal)	278	7790	VE8	Canada, Northwest Terr., Yellowknife	320	2357	8Q	Guyana, Georgetown	135	3018
I-IZ	Italy, Rome	52	4789	VK	Australia, Brisbane	267	8920	8Z4	Saudi Arabia/Riyadh Neutral Zone	40	6690
IC	Casri Is.	51	4913	VK	Australia, Darwin	301	3388	8G	Ghana, Accra	87	5825
IG	Lampedusa Is.	57	5138	VK2	Norfolk Is.	251	1824	8G	Malta, Valletta	65	5178
IS	Pantelleria Is.	56	5008	VK2	Tasmania Is., Hobart	249	9713	8G	Oaxa (Matamoros)	65	5178
IS	Sardinia, Cagliari	56	4792	VK3	Norfolk Is.	251	1824	8G	Zambia, Lusaka	84	8225
IT	Sicily, Palermo	54	5004	VK3	Christmas Is.	336	10094	8G	Kuwait, Al-Kuwait	38	6787
JA.JS	Japan, Tokyo	223	6279	VK3	Cocos (Keeling) Is.	137	11269	8G	Siera Leone, Freetown	84	8225
JH1	Osaka (Yokohama)	218	5780	VK3	Macquarie Is.	229	9392	8G	Nepal, Katmandu	7	7593
JH1	Miami-Torishima (Marcus Is.)	306	6431	VK3	Macquarie Is.	229	9392	8G	Zaire, Kinshasa	89	8750
JH1	Ryukyu Is. (Okinawa)	212	5780	VK3	Macquarie Is.	229	9392	8G	Burundi, Bujumbura	335	8220
JH1	Mongolia, Ulan Bator	350	6169	VK3	Macquarie Is.	229	9392	8G	Nepal, Katmandu	7	7593
JW	Switzerland	14	3643	VO2	Canada, Labrador, Goose Bay	49	1488	8G	Zaire, Kinshasa	89	8750
JW	Jan Masada, Jerusalem	23	3253	VP1	Belize, Belize	181	1722	8G	Burundi, Bujumbura	335	8220
JW	Jordan, Amman	45	6207	VP2	Dominica, Roseau	132	2445	8G	Nepal, Katmandu	7	7593
JW	Djibouti, Djibouti	52	7579	VP2	Anguilla, Croux Hill	132	2445	8G	Zaire, Kinshasa	89	8750
JW	Guinea, Conakry	93	4922	VP2	St. Kitts, Nevis	132	2445	8G	Burundi, Bujumbura	335	8220
JW	Guinea Bissau, Bissau	93	4729	VP2	St. Lucia, Castries	132	2445	8G	Nepal, Katmandu	7	7593
				VP2	Montserrat, Plymouth	132	2445	8G	Zaire, Kinshasa	89	8750
				VP2	St. Vincent, Kingstown	134	2559	8G	Burundi, Bujumbura	335	8220
				VP2V	British Virgin Is., Road Town	133	2161	8G	Nepal, Katmandu	7	7593



The table below shows the great circle bearing in degrees and the distance in statute miles from the point indicated above to countries throughout the world having licensed radio amateurs.

PREFIX	COUNTRY	BEARING	MILES	PREFIX	COUNTRY	BEARING	MILES	PREFIX	COUNTRY	BEARING	MILES
A.K.N.W.	USA, San Francisco	208	1622	KC4	Nassau Is.	118	1523	VP5	Turks Is., Grand Turk	106	1637
A.K.N.W.	USA, Chicago	24	938	KC6	Caroline Is. (Ponape)	285	6965	VP5	Caicos Is., Kay	105	1549
A.K.N.W.	USA, New York	61	1478	KG4	Guantanamo Bay (Cuba)	113	1445	VP8	Falkland Is., Stanley	156	6095
A3	Pakistan, Karachi	21	8443	KG6	Mariana Is. (Guam)	207	7457	VP8	South Georgia Is.	158	6715
A3	Batavia, Java	100	8915	KH6	Hawaii, Honolulu	277	3913	VP8	South Orkney Is.	158	6888
A3	Tokyo, Okinawa	247	8152	KH6	Kure Is., Japan	282	4084	VP8	South Sandwich Is.	164	6649
A3	Oman, Muscat	37	8150	KJ6	Johnston Is.	278	4472	VP8	South Shetland Is.	169	7236
A4	Bhutan, Thimphu	35	7306	KL6	Alaska, Anchorage	327	3271	VP8	Bermuda Is., Hamilton	177	1005
A6	United Arab Emirates, Dubai	31	8182	KP4	Chagoss Is., Diego Garcia	408	4928	VR1	British Phoenix Is.	208	6519
A6	Doha, Qatar	33	8086	KP4	Puerto Rico, San Juan	107	2023	VR1	Gilbert Is., (Tarawa)	272	6287
A6	Bahrain, Manamah	33	7935	KV4	Palmyra Is., Northern	107	2023	VR1	Line Is., Northern	381	4474
AV	Taiwan, Taipei	324	7986	KV4	American Samoa, Pago Pago	251	5871	VR6	Pitcairn Is.	215	4431
BE	China, Peking	336	7218	KX6	U.S. Virgin Is., Charlotte Amalie	106	2028	VR6	Line Is., Central & Southern	228	4660
CE	Chile, Santiago	158	4529	KZ5	Marshall Is. (Kwajalein)	282	6367	VY1	Brunei	315	9311
CEAN-AZ	South Shetland Is.	164	6649		Canal Zone, Colon	142	1750	VY6	Hong Kong, Victoria	328	8368
CEAN-EX	Easter Is.	194	4031	LA-LJ	Norway, Oslo	30	4985	VY7	Andaman Is., Port Blair	348	951
CEAN-XZ	San Pedro de Macoris	164	3932	LA	Argentina, Buenos Aires	161	5102	VY7	Nicaragua, Managua	348	951
CEB	Juan Fernandez Is.	165	4541	LX	Luxembourg, Luxembourg	41	5140	VY7	Nicobar Is., Banana	345	9830
CM, CO	Cuba, Havana	116	1653	LZ	Bulgaria, Sofia	40	6078	VY1	Laccadev Is., Kawaratti	372	951
CEB	Morocco, Casablanca	81	4674						Canadian Yukon, Whitehorse	332	2811
CEB	Bolivia, La Paz	146	3657	MA	San Marino	44	5594	XZ, XF	Mexico, Mexico City	198	781
CEB	Venezuela, Caracas	128	8368						Rivilla Gigida Is.	236	1232
CR	Portugal, Lisbon	56	4787	OA	Peru, Lima	154	3141	XF4	Port of Spain, Trinidad	178	6715
CT	Azores Is., Horta	61	3760	OD	Lebanon, Beirut	40	8976	XU	Cambodia, Phnom Penh	332	8258
CT3	Mauritius Is., Luncheon	65	4721	OD	Austria, Vienna	55	5999	XU	Vietnam, Hanoi	335	8659
CT3	Uruguay, Montevideo	147	5166	OE	Finland, Helsinki	26	5333	XU	Laos, Vientiane	337	8974
CT3	Nauru Is.	273	6170	OK, OL	Czechoslovakia, Prague	38	5446	XZ	Burma, Rangoon	345	912
C5	Andorra, Andorra	40	5180	OX	Belgium, Brussels	50	5030				
C5	The Gambia, Bathurst	84	5093	OX	Greenland, Godthab	26	3222				
C5	Algeria, Algiers	102	1176	OX	Faeroes Is., Thorshavn	32	4376				
CB, CN	Mozambique, Maputo	98	9311	OX	Denmark, Copenhagen	33	5188				
DA-DL	West Germany, Bonn	40	5146	PA, PI	Netherlands, Amsterdam	39	5038	YD	Albanian, Kabul	14	7854
DM	East Germany, Berlin	36	5297	PJ	Curaçao Is., Willemstad	120	2098	Y1	Indonesia, Jakarta	314	10251
DM	Philippines, Manila	317	8515	PJ	Aruba Is., Oranjestad	120	1998	Y1	New Hebrides, Vila	257	7207
D2, D3	Angola, Luanda	89	7836	PJ	Sonora Is., Kralendijk	120	2146	Y1	Syria, Damascus	157	1371
D5	Cape Verde, Praia	85	4672	PJ	Sint Eustatius Is.	104	2196	Y1	Nicaragua, Managua	348	951
D5	State of Comoro, Moroni	74	9515	PJ	Saba Is.	104	2196	Y1	Romania, Bucharest	361	4164
EA	Spain, Madrid	53	5004	PJ	Sint Maarten Is.	104	2196	YU	Saint John's, St. John's	408	5875
EA6	Batavia Is., Palma de Mallorca	51	5337	PP, PY	Brasilia, Brasilia	128	4474	YU	Yugoslavia, Belgrade	40	5875
EA6	Cenary Is. (Gran Canaria	69	4741	PY	Fernando de Noronha Is.	108	4796	ZA	Venezuela, Caracas	121	2287
EA6	Casta, Costa Rica	50	5071	PY	Trinidad & Martin Vaz Is.	120	5614	ZD	Albania, Tirana	43	5046
EA6	Malilla	58	5202	PZ	Surinan, Paramaribo	114	3101	ZD	St. Helena Is.	58	5071
EL, SL	Ireland, Dublin	41	4584	PZ	Papua New Guinea, Port Moresby	275	8220	ZD	Ascension Is.	101	5990
EP	Liberia, Monrovia	68	5654	S-M				ZD	Laos, Vientiane	337	8974
EP	Eran, Tehran	78	7482	S-M	Sweden, Stockholm	29	5230	ZD	Gough Is.	128	7293
EP	Ichpadd, Adnan Ababa	56	8401	SP	Poland, Warsaw	29	5230	ZE	Kookis, Salisbury	89	8995
FBW	France, Paris	43	5011	ST	Sudan, Khartoum	55	7757	ZK1	Mayman Is., Georgetown	126	1172
FBW	Kerguelen Is.	153	10889	SV	Egypt, Cairo	45	7013	ZK1	Cookis, (Rangoon)	239	551
FC	Guadeloupe, Basse-Terre	107	2321	SV	Greece, Athens	45	7013	ZK2	Nius Is., Aiofi	248	5099
FC	Guadeloupe, Grande-Terre	107	2321	SV	Crete, Iraklion	45	6521	ZK2	New Zealand, Auckland	237	7409
FC	Guadeloupe, Pointe-a-Pitre	107	2321	SV	Hydruntine Is. (Rhodes)	59	6600	ZL	Avalon	228	6639
FC	Guadeloupe, St. Pierre	107	2321	SV	Bangladesh, Dacca	354	8712	ZL	Campbell Is.	222	7046
FC	Guadeloupe, St. Vincent	107	2321	SV	Seychelles Is.	53	9916	ZL	Chetum Is.	227	8283
FC	Guadeloupe, St. John	107	2321	SV	Franker, Umitas	108	4796	ZL	Paravau, Aucion	143	4530
FC	Guadeloupe, St. Thomas	107	2321	SV	St. Thomas & Principe	84	6968	ZL	St. Africa, Capetown	113	8508
FC	Guadeloupe, St. John	107	2321	SV	Turkey, Ankara	37	6596	ZM7	Prince Edward & Marion Is.	129	8079
FC	Guadeloupe, St. Vincent	107	2321	SV	Iceland, Reykjavik	30	3892	ZM7	Nobdia, Windhoek	101	8294
FC	Guadeloupe, St. John	107	2321	SV	Guatemala, Guatemala	100	1000	ZM7			
FC	Guadeloupe, St. Vincent	107	2321	SV	Costa Rica, San Jose	149	1655	ZM7			
FC	Guadeloupe, St. John	107	2321	SV	Cocos Is.	78	7121	ZM7			
FC	Guadeloupe, St. Vincent	107	2321	SV	Cameroon, Yaounde	158	1822	ZM7			
FC	Guadeloupe, St. John	107	2321	SV	Central African Republic, Bangui	74	7529	ZM7			
FC	Guadeloupe, St. Vincent	107	2321	SV	Congo, Brazzaville	83	7585	ZM7			
FC	Guadeloupe, St. John	107	2321	SV	Gabon, Libreville	83	7585	ZM7			
FC	Guadeloupe, St. Vincent	107	2321	SV	Chad, Fort-Lamy	89	8993	ZM7			
FC	Guadeloupe, St. John	107	2321	SV	Ivory Coast, Abidjan	85	6107	ZM7			
FC	Guadeloupe, St. Vincent	107	2321	SV	Benin, Porto-Novo	81	6519	ZM7			
FC	Guadeloupe, St. John	107	2321	SV	Mal, Bamako	60	5628	ZM7			
FC	Guadeloupe, St. Vincent	107	2321	SV	Touval Is.	206	6403	ZM7			
FC	Guadeloupe, St. John	107	2321	SV				ZM7			
FC	Guadeloupe, St. Vincent	107	2321	SV				ZM7			
FC	Guadeloupe, St. John	107	2321	SV				ZM7			
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FC	Guadeloupe, St. Vincent	107	2321	SV				ZM7			
FC	Guadeloupe, St. John										

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OPR. E. H. MORIN

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DATE	TIME ON	TIME OFF	STATION CALLED	Called By	FREQ	EMM	PWR	ANT	LOCATION	NAME
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Time	Call	Response	Frequency	Power	Distance	Remarks
2-1	220A KMT2	—	7031	A1-50	509	
	223A WAGRM1	—	7031		579	
	224A CQ	—	7031		579	
	225A WCPYN	—	7031		579	
9-10	23A WAGRM1	—	7040	A1-50	589	
	23A K3F-DQ	V	7040	A1-50	579	449 23A
	23A WAGRM1	—	3720	A1-50	589	
	23A CQ	—				
11 35	CQ	WAGRM1	7020	A1-50	59	59 1240 9-11
9-17	23A K3F-DQ	V	7020	A1-50		
	23A CQ	WAGRM1	7035	A1-50	559	589 23A





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Form 3220

PART 1  
TIMESTATION  
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Route

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GPH

NAME

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ACT. S. T. A.

1-23													
3 <sup>58</sup>	W55AH	—	4030	A1-30	589	—				Conquer V. wing	—		
3 <sup>59</sup>	CP	—	4030	A1-30	—	—							
1-26													
1442	CP	—	7630	A1-50									
1-28 1 <sup>36</sup>	CP	—	4030	A1-50									
2 <sup>38</sup>	W1APU	—	4030	A1-50	569								
2-1 1 <sup>40</sup>	W6RDB	—	3620	A1-50									
1 <sup>42</sup>	W6RDB	—	3620	A1-50									
1 <sup>43</sup>	CP	—		A1-50									
2 <sup>44</sup>	W34.6	—		A1-50									
2 <sup>45</sup>	W1TLZ	✓	3620	A1-50	569	509	2 <sup>46</sup>			W1TLZ	509		
2-3													
2 <sup>48</sup>	CP												
2 <sup>50</sup>	W6GYT	✓	3630	A1-50	569	509	2 <sup>51</sup>			W6GYT	509		
2-4													
2 <sup>52</sup>	W6SCD	—	4040	A1-50	579					W6SCD			
2 <sup>53</sup>	W6PBA	—	2130	A3-30	57								
2 <sup>54</sup>	W6PBA	—	"	A3-30	57								
2-5 2 <sup>55</sup>	CP	—	3520	A1-50									
2 <sup>56</sup>	W7SAD	—	3520	A1-50	519								
2 <sup>57</sup>	CP	—	3520	A1-50									
2 <sup>58</sup>	W7444N	✓	"	A1-50	579	459	2 <sup>59</sup>			W7444N			
2 <sup>59</sup>	CP	—	7030	A1-50									
2 <sup>60</sup>	W7CSH	—	"	A1-50	479								
2-6 1 <sup>38</sup>	W55K21	✓	3030	A1-50	579	579	2 <sup>40</sup>			W55K21	509		
1 <sup>39</sup>	W55K21	✓	2110	A1-30	579	579	4 <sup>41</sup>			W55K21	509		
2-9 1 <sup>37</sup>	CP	—	1525	A3-40									
2 <sup>38</sup>	CP	—	3820	A3-40									
2 <sup>39</sup>	W6PBA	—	3820	A3-40									
2 <sup>40</sup>	CP	—	3820	A3-40									
2 <sup>41</sup>	W6PBA	—	7030	A1-50									
2 <sup>42</sup>	W6PBA	✓	7618	A1-50	579	559	2 <sup>43</sup>			W6PBA	509		
2-11 4 <sup>44</sup>	W6PBA	—	4030	A1-50	579								
4 <sup>45</sup>	W6PBA	—	4030	A1-50									
4 <sup>46</sup>	W6PBA	—	"	"	579								
4 <sup>47</sup>	W6PBA	—	"	"	579								
4 <sup>48</sup>	W6PBA	—	"	"	579								
2-18 3 <sup>49</sup>	W6PBA	—	7177	"	579								



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239 WPHDFC — 7020 A1-50 569

2-27

238 WPHDH — 7020 A1-50 579

238 WPHHNM ✓ 35370 A1-50 579 449 238

58 RPHDC — 11 11 589

238 WPHBS1 — 11 1 569

238 WPHBS2 — 7103 579

2-28

147 W28R1 ✓ 3570 A1-50 569 519 238

238 W28R2 ✓ 3610 A1-50 569 569 238

1238 WPH28W ✓ 3520 A1-50 579 579 238

108 W28R3 — 11 A1-50 569

108 28 — 11 A1-50 —

108 28 — 20280 A1-50

108 28 — 11

7-3

338 43W40 ✓ 7020 A1-50 589 519 238

5-2

238 28 — 3640 A1-50 579 569 238

5-6 105 50 — 410 A1-50

124 W28DA — 1 1 569

124 28 4200 11 A1-50 569 569 238

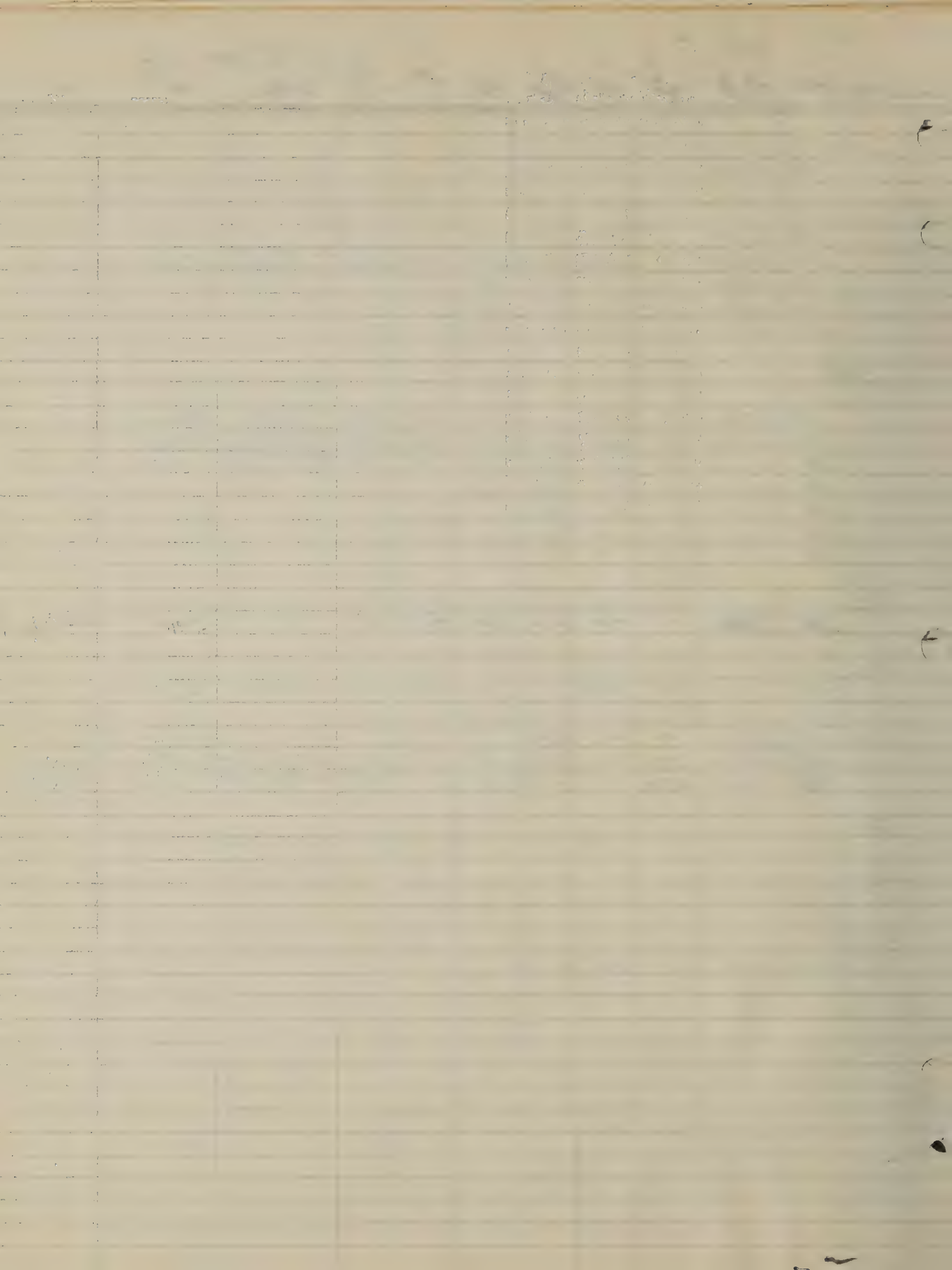
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Called	Result	FREQ.	MISSION + POWER REPORT	MIS REPORT	END TRANS.	QTH.	NAME.	MISC.
1-17-67	CQ	—	—	—	—	—	—	—
1-18-67	CQ	—	—	—	—	—	—	—
1-19-67	CQ	—	—	—	—	—	—	—
1-20-67	CQ	—	—	—	—	—	—	—
1-21-67	CQ	—	—	—	—	—	—	—
1-22-67	CQ	—	—	—	—	—	—	—
1-23-67	CQ	—	—	—	—	—	—	—
1-24-67	CQ	—	—	—	—	—	—	—
1-25-67	CQ	—	—	—	—	—	—	—
1-26-67	CQ	—	—	—	—	—	—	—
1-27-67	CQ	—	—	—	—	—	—	—
1-28-67	CQ	—	—	—	—	—	—	—
1-29-67	CQ	—	—	—	—	—	—	—
1-30-67	CQ	—	—	—	—	—	—	—
2-1-67	CQ	—	—	—	—	—	—	—
2-2-67	CQ	—	—	—	—	—	—	—
2-3-67	CQ	—	—	—	—	—	—	—
2-4-67	CQ	—	—	—	—	—	—	—
2-5-67	CQ	—	—	—	—	—	—	—
2-6-67	CQ	—	—	—	—	—	—	—
2-7-67	CQ	—	—	—	—	—	—	—
2-8-67	CQ	—	—	—	—	—	—	—
2-9-67	CQ	—	—	—	—	—	—	—
2-10-67	CQ	—	—	—	—	—	—	—
2-11-67	CQ	—	—	—	—	—	—	—
2-12-67	CQ	—	—	—	—	—	—	—
2-13-67	CQ	—	—	—	—	—	—	—
2-14-67	CQ	—	—	—	—	—	—	—
2-15-67	CQ	—	—	—	—	—	—	—
2-16-67	CQ	—	—	—	—	—	—	—
2-17-67	CQ	—	—	—	—	—	—	—
2-18-67	CQ	—	—	—	—	—	—	—
2-19-67	CQ	—	—	—	—	—	—	—
2-20-67	CQ	—	—	—	—	—	—	—
2-21-67	CQ	—	—	—	—	—	—	—
2-22-67	CQ	—	—	—	—	—	—	—
2-23-67	CQ	—	—	—	—	—	—	—
2-24-67	CQ	—	—	—	—	—	—	—
2-25-67	CQ	—	—	—	—	—	—	—
2-26-67	CQ	—	—	—	—	—	—	—
2-27-67	CQ	—	—	—	—	—	—	—
2-28-67	CQ	—	—	—	—	—	—	—
2-29-67	CQ	—	—	—	—	—	—	—
2-30-67	CQ	—	—	—	—	—	—	—
3-1-67	CQ	—	—	—	—	—	—	—
3-2-67	CQ	—	—	—	—	—	—	—
3-3-67	CQ	—	—	—	—	—	—	—
3-4-67	CQ	—	—	—	—	—	—	—
3-5-67	CQ	—	—	—	—	—	—	—
3-6-67	CQ	—	—	—	—	—	—	—
3-7-67	CQ	—	—	—	—	—	—	—
3-8-67	CQ	—	—	—	—	—	—	—
3-9-67	CQ	—	—	—	—	—	—	—
3-10-67	CQ	—	—	—	—	—	—	—
3-11-67	CQ	—	—	—	—	—	—	—
3-12-67	CQ	—	—	—	—	—	—	—
3-13-67	CQ	—	—	—	—	—	—	—
3-14-67	CQ	—	—	—	—	—	—	—
3-15-67	CQ	—	—	—	—	—	—	—
3-16-67	CQ	—	—	—	—	—	—	—
3-17-67	CQ	—	—	—	—	—	—	—





[illegible]

- 1 VIRIA DE
- 2 EPP
- 3 TENN
- 4 CLARK
- 5 ADAMSON
- 6 MASS
- 7 OHIO
- 8 ILL
- 9 IOWA
- 10 N.Y.
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1976

11. 2. 1975

244

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$$\begin{array}{r} 19 \\ 4 \overline{) 760} \\ \underline{76} \phantom{0} \\ 0 \phantom{0} \\ 26 \end{array}$$







12-72

26/11/1944

13 June 1964

7725 G.D. Ave

12-13-71

5 08 PM	CQ	VE2D4W	589	589	14150	5130	Montreal, Canada.	
5 20 PM	CQ	VE7BBE	579	589	14150	5130	VANCOUVER, B.C.	
5 40 PM	CQ							
12 14	711							
					14130			
9 46 PM	CQ	VE2BUS	549	549	14130	915	Arcelette, Canada.	Sony.
12 24	711							
4 40	CQ	VE3CCE	579	579	14060	436	Canada.	
4 35	CQ	WATAXT	579	579	14060	518	WMLY	Bremerton Wash. U





190 watts. input VFO.

SHORT BURST

Form 3220

0.272min. J. op. He mo off. <sup>HC.</sup> ~~Frq.~~ ANTI

called. ars. By.

1-1-72

420P CQ WA7ITF 579 579 ~~440P~~ 14080

Ted. Salt Lake City, UTAH.

450P CQ WB6LGV 569 569 5<sup>25</sup> 14060

DICK. San Jose, Calif.

615P CQ VB6AUZ 579 569 6<sup>50</sup> 14080

Jim Calgary, Alberta, Can.

6<sup>50</sup> CQ —1-15-72 <sup>450P</sup> CQ ? 14070518 VE1UY ✓ 579 569 5<sup>20</sup> 14070 E. TOBBY HALIFAX N.S.

559 CQ — 14080

605P CQ — 14085

6120 CQ — 14150

3-20-72 A1 185 WATTS

835P CQ WB5AHX 579 579 ~~845P~~ 14070 Ben.

— GAN.

846 CQ WA7HGY 579 579 9<sup>10</sup> 14070 " Pat, Olympe N.Y.C.

918 VE7NX X 589

3-21-72

825P CQ VE7AGP 579 589 8<sup>20</sup> 14060 " Harold Halifax Nova Scotia.820P CQ WA7IRZ 589 589 9<sup>00</sup> 14060 " Brian Tempe, Arizona.

3-25-72

1020P CQ — 14060

1030P CQ WA7MID 579 589 11<sup>05</sup> " ~~Beam~~ Rick CREG1100P CQ WB6GX? 559 569 11<sup>30</sup> " 1 Loran Burbank Cal.

847P

3-27-72 CQ H7YHP 579 589 9<sup>00</sup> 21070 D.P. Bill Wilder Idaho.914P CQ W6DRC 579 599 9<sup>20</sup> " D.P. Bill Long Beach Cal.

944P OA9BI — 579

3-28-72

835P CQ W7DJS 579 589 9<sup>10</sup> 21070 " Don. Seattle Wash.





3-29-72

50P	CQ	—				
800P	CQ	WATRAI	569	589	Free 8	25P.

4-1-72

180 WARTS.

410P.	WAGHNS MOB	58   58	420P.	A3	14287 PUTG.	LANSING	ILU
540P.	X02 VBU	579 -		A1	21080		
549P	HH6-GJY	579. -		A1	21080		

4-2-72

21060

40P	CP	WHARK	589-589	A1	21060	Holcom, FLA.	VOS.
52P.	CQ	—			21060		
535	PY5BAZ	—	579.		21000	Red Hill, Bery, D.	
54P	CQ	—			21060		
6P	CQ.	—			21060		
6P5	CQ	—			"		

4-3-72

93P	CO	W7ANK	589 589 589				
93P	902	W9JGA	579 579 10P				

old for W9JGA  
in and around W9JGA and 589

4-4

900P	W9JWS	—		A3	14275	Red Hill, Bery, D.	
91P	CQ	VE7AYV	539 579	A1	14460	Richmond, B.C.	
94P	CQ	NR65GT	579 569	A1	14360	Chambers, Cal.	
4-5	9P	Y06PAT	679 619	A1	14460	Chambers, Cal.	
9P	QRZ	WLYE	579 589	A1	14460	Chambers, Cal.	



Date & Time		called	called by	W1 apt	MU apt	sent off	FREQ	Location	Remarks
11-7-72									
9:30	VE 8MM	✓		579	579	7 1/2	14000	WATERMAN KORON	TERRY TOW
12 Low day									
9:30	VE 6MM	—		579	—			STANLEY BIRCH	MALIN
9:30	CG	WAH/HPA		579				2.2500 GPR	DOWNED
10:17	NO 100	—		579					
10:18	Y-7112	—		569					
10:20	21300	—		549					
10:40	CG	—							
10:50	CG	—							
10:59	21100R	—		579				ENTERING 2.50	
11:03	CG	—							
11:10	2K1AR								
11:370	VE 910								
4-8-72									
7:30	W5V1N	✓		579	579	7 1/2	1400	Cath. Bay LA F1000K	
7:30	QAC	VE204U		579	579	7 1/2	1400	California H2000	DID. 1000
10:20	CG	WATSON		579	579	10 1/2	1400	Clara Island D.C.	
10:40	CG	VE 7001		579	579	11 1/2	1400	WATERMAN D.C.	
4-9-72									
7:30	CG	—							
7:25	FM 7WS	✓		579	579	7 1/2	1400	Full 10000 MARTIN UNCOAT 6079	
7:30	CG	—							
7:30	CG	—							
7:30	CG	—							
7:30	CG	—							





1022-22

4-9-72

932	CG	W60R2	579	579	14,741	952	2A Sub
936	CG	VE 7CE	579	579	14,111	113	VA 1000 RC

4-10-72

892	XG/TX	—			2402R		
894	VE 5T8	✓	579	579	71601		Yokota, Japan

4-11-72

750	CG	—			14001		
717	W60R2	✓	579	579	579	14,741	Hulu Sub II
932	SM300L	—	579		14001		Bud
942	CG	—			579		
943	SM300L	—	579				India
947	VAIFJ	—	579				UAXR

4-13-72

779	CG	VE 2AT	579	579	14001	15	QIANJIA
782	CG	—					China

4-13-72

892	CG	—					
932	SM300L	—	579				
942	CG	—					

4-14-72

932	YVITD	—	579				
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01 100watts

4-15-12

4-15	CO	—	579	100W	
4-15	WAB/EP	—	579		
4-15	CO	—	579		
4-15	WAB/EP	—	579		
4-15	CO	—	579		
8-15	CO	V613C	179	100W	100W
9-15	CO	—	579		
10-15	ORSDX	—	579		100W
9-15	VINIR	—	579		
10-15	CO	W7A50	179	100W	100W
10-15	UTSIT	—	579		
11-15	VADY	—	579		
11-15	W7A50	—	579		

4-16

8-16	CO	W7A50	179	100W	100W
9-16	CO	—	579		
9-16	WAB/EP	—	579		
10-16	CO	—	579		

4-17

8-17	CO	—	579		
9-17	CO	—	579		
10-17	CO	WAB/EP	179	100W	100W
11-17	CO	—	579		



# W9cey

## LOG

CENT.

OPR. J. R. M. J.

DATE	TIME OFF	TIME ON	STATION-CALLED	CALLED BY	FREQ	FM	PWR	ANT.	LOCATION	NAME
1972										
4/17	8:40p		CQ	-	14100KC	A1	180	BEAM		
	8:59p		CQ	-	"	A1	180	"		
	10:00p	10:15p	WB6LLE	US	"	A1	180	"	GLENDALE, CAL.	VIRG.
	10:17p		CQ	-	7060KC	A1	180	DIPOLE		
4/19										
	7:45p		CQ	-	74070KC	A1	180	BEAM		
	7:50p	8:00p	WB5BQV	US	14070KC	A1	180	"	TUCSON, ARIZ	RICK
	8:35p	8:55p	RQ	K950N	14070KC	A1	180	"	RT330483	RON
4/20			CQ	W7CUU	14070KC	A1	180	"	PHOENIX, ARIZ	LON
4/23	8:40p	-	CQ	-	14070KC	A1	180	"		
	8:50p	-	CQ	-	"	A1	180	"		
	8:58p	9:05p	CQ	WA2GUR	"	A1	180	"	DIXHILL, NY	AL
4/26	9:20p	9:42p	CQ	W8LJH	7070KC	A1	180	DIPOLE	LORAIN, OHIO	BILL
	9:55p		CQ	-	14070KC	A1	180	BEAM		
5/8	9:30p		CQ	-	14100KC	A1	180	BEAM		
	9:37p		WA6CIL	-	"	A1	180	"		
	9:38p		W0GBC	-	"	A1	180	"		
	9:59p									
6-22	4:30p		CQ	-	14060	A1	180	BEAM		
	8:59p		CQ	-	14070	A1	"	"		
6-28	8:59p		CQ	-	14100	A1				
	9:17p	9:45p	CQ	WB9HTW	14070	A1	180	BEAM	CAGO HTS,	DICK
7-2	3:40p	4:00p	CQ	VE5ALS	14100	A1	180	BEAM	ALSAHA	DON
	7:12p	7:32p	CQ	W1AQE	14070	A1	180	"	SABINIA, CANADA	STENGE
	8:50p	8	CQ	-					MILWAUKEE	NEAR PGAWA
7-6	8:00p		CQ	-	14000	A1	180	BEAM		
7-23	2:20p	2:50p	W49HNS	-	14322	A1	180	Beam		
	3:00p		CQ	-	14080	A1	180	Beam		
8-5	12:40p		CQ		14000	A1	180	Beam		
8-6	9:20p		CQ		3700	A1	100	Beam		
	9:20p	10:00p	W1V9KRV	-	3700	A1	100	"	South Hill	Bob
8-7	10:30p	10:40p	CQ	WA7ROP	14000	A1	180	Beam	San Jose	GR





# Wacey

## LOG

OPR. L. H. Mann Jr. 1972

DATE	TIME OFF	TIME ON	STATION-CALLED	Called By	FREQ	FM	PWR	ANT.	LOCATION	NAME
8-7	8 <sup>30</sup>		CQ	—	14060	A1	180	Beam		
	9 <sup>05</sup>		W2MFF	—	14060	A1	180	Beam		
	9 <sup>07</sup>	9 <sup>30</sup>	CQ	K7POZ/7	14060	A1	180	Beam	DUGWAY, UTAH	HARRY MIL. BASE.
8-15	7 <sup>30</sup>	7 <sup>50</sup>	CQ	—	14070	A1	180	Beam		
8-19	7 <sup>50</sup>	8 <sup>30</sup>	CQ	WA7NDB	14100	A1	180	Beam	CAMAS, WASH.	63, Retired.
	10 <sup>30</sup>		CQ	—	14100	A1	180	"		
	10 <sup>10</sup>		WA7CIP	—	14100	A1	180	"		
	10 <sup>25</sup>	10 <sup>45</sup>	CQ	WA9HMY/5	"	"	"	"	LOST ORN QSB.	
	10 <sup>50</sup>	10 <sup>55</sup>	W2BBQ	✓	14100	A1	180	"	QSB.	
	11 <sup>00</sup>	11 <sup>10</sup>	CQ	WA6OCY	"	A1	180	"	"	
8-20	3 <sup>10</sup>	3 <sup>10</sup>	CQ	K1EDL	14100	A1	180	"		
	3 <sup>20</sup>	3 <sup>40</sup>	CQ	K1CFF	"	"	"	"		
	3 <sup>20</sup>	4 <sup>20</sup>	CQ	K5GDT	"	"	"	"	ALBUQUERQUE, N. MEX.	
8-26	8 <sup>00</sup>		CQ	WALAHN	21080	A1	180	Beam		
8-27	1 <sup>40</sup>		CQ	—	21080	A1	180	Beam		
	1 <sup>30</sup>		ZS3XG	—	"	"	"	"		
	1 <sup>50</sup>	3 <sup>00</sup>	CQ	—	"	"	"	"		
	8 <sup>30</sup>		CQ	—	14100	A1	180	Beam		
8-28	8 <sup>20</sup>	9 <sup>00</sup>	CQ	WB4MYW	14060	A1	180	Beam	MIAMI, FLORIDA	JOHN, 60 YRS. PAN AM A/R.
8-29	9 <sup>10</sup>		VP9DR	—	14060	A1	180	Beam		
	9 <sup>10</sup>	9 <sup>30</sup>	CQ	VP9DR	14060	A1	180	Beam	Bermuda	Derrick
	9 <sup>45</sup>	10 <sup>05</sup>	CQ	W5YN	14100	A1	180	"	NEW HAM.	BILL
	10 <sup>10</sup>		CQ	—	"	"	"	"	NEW ORLEANS, LA.	
	10 <sup>10</sup>	10 <sup>30</sup>	W9CEV	VP9DR	14100	A1	180	Beam	BOX 275 HAMILTON	
								QSL SENT	BERMUDA,	DERICK QSL
8-30	1 <sup>40</sup>		CQ	—	"	"	"	"		
	9 <sup>10</sup>		H8ORD	—	"	"	"	"		
	9 <sup>10</sup>	9 <sup>30</sup>	W2QMF	✓	"	"	"	"	Secaucus NJ,	JOHN





# Wacey

## LOG

OPR. E.H. MORIN JR.

1972

DATE	TIME ON	TIME OFF	STATION-CALLED	Called By	FREQ	FREQ	PWR	ANT.	LOCATION	NAME
1972										
9-2										
	950p	—	CQ	—	14060	A7	180	Beam	Ø	
	1000p	—	HL7FSV	—	"	"	"	"	ALASKA	
	1000p	—	CQ	—	"	"	"	"		
	1020p	1030p	CQ	H7AB	"	"	"	"	RENO NEVADA	JOHN
9-3	1030p	1130p	CQ	WOA VØ	"	"	"	"	Lake George	Colorado SIM
	1030p	1035p	VOZAG	✓	14080	"	"	"	Salvador City	Salvador M
									DON. BOX	#493
	1040p	—	UA3LAR	—	"	"	"	"	USSR	
	1042p	—	IZAYX	—	"	"	"	"	ITAYX	
	1045p	—	HK5CTH	—	"	"	"	"	COLUMBIA SA.	
	1048p	—	2L2CCK	—					NEW ZEALAND	
9-4										
	1230p	—	WB6DUS	—	"	"	"	"		
	1230p	—	WB5GYY	—	"	"	"	"		
	100	140p	CQ	WB6DUS	14120	"	"	"	Oceanside City	Chas
	140p	—	CQ	—	"	"	"	"		62 YRS.
	1430p	—	UA3ERI	—	"	"	"	"	USSR	
	1530p	210p	VO7BKE	✓	14070	"	"	"	WEST VANCOUVER	BC Canada
									LLOYD	
	530p	—	CQ	—	21060	"	"	"		
	730p	800p	CQ	H2ZX0	14060	"	"	"	Bellville	MD MILT.
9-10	440p	450p	CQ	—	14060	"	"	"		
	444p	—	ZL3X0	—	"	"	"	"		
	450p	510p	VE5X0	✓	"	"	"	"	Regina	SASKATCH. CANADA
									Boris	
	730p	755p	W1BZE	✓	"	"	"	"	IVORYTON	CONN ALEX
9-11	700p	—	CQ	—						
	700p	710p	UA9HL	✓	14068	"	"	"	TOMSKTOMSK	USSR
									VICTOR	569 559

11. 11. 11.

## 1972

OPR. E. H. MORIN JR

DATE	TIME EST	TIME LOC	STATION-CALLED	CALLED BY	FREQ	FM.	PWR.	ANT.	LOCATION	NAME
9-12	64 <sup>30</sup>		CQ							
	70 <sup>00</sup>	72 <sup>30</sup>	CQ	WAIQEX	14080	✓	180	Bear	HANOVER MAINE, DAVE.	G SLEDGE.
9-16	710	73 <sup>30</sup>	VE3FTV	✓	"	✓	180	"	Toronto ONT, Canada.	John.
	75 <sup>30</sup>	80 <sup>00</sup>	CQ	VE3FAH	"	"			WINDSOR, ONT, Canada.	Rod.
	81 <sup>50</sup>	-	CQ	—	"	"	"	"		
	82 <sup>30</sup>	-	PYTBPC	—	"	"	"	"	Recife, Brazil.	
	100 <sup>30</sup>	-	CQ	—	"	"	"	"		
	102 <sup>30</sup>	103 <sup>30</sup>	NB6GSS	✓	"	"	"	"	PICO RIVERA, California.	AUSTIN.
9-17		84 <sup>30</sup>	85 <sup>30</sup>	CQ	W6JAF	#	"	"	LA, California	J.H.N.
	93 <sup>30</sup>	95 <sup>30</sup>	CQ	K7TED	"	"	"	"	HEARNS, UTAH	DILL.
9-18	94 <sup>30</sup>	-	CQ	—	"	"	"	"		
9-19	84 <sup>30</sup>	90 <sup>30</sup>	CQ	WA5PSW	"	"	"	"	AUSTIN, TEXAS,	MARVIN.
	91 <sup>30</sup>	-	KH6HPQ	—	"	"	"	"	KAILUA, OAHU, H.I.	
	92 <sup>30</sup>	-	CQ	—	14090	"	"	"		
	922	-	OATBS	—	"	"	"	"		
	93 <sup>30</sup>	94 <sup>30</sup>	KH6HPQ	✓	"	"	"	"	KAILUA, OAHU, H.I.	MARK
9-20	81 <sup>30</sup>	83 <sup>30</sup>	UA9RL	✓	14080	"	"	"	NOVOSIBRSK USSR.	VICTOR.
	94 <sup>30</sup>	95 <sup>30</sup>	CQ	W7GCCO	"	"	"	"	ZONE 19 USSR.	
	93 <sup>30</sup>	-	W7TYE	—	"	"	"	"	POCATELLO, IDAHO,	RUSTY.
	93 <sup>30</sup>	94 <sup>30</sup>	KL7AMD	—	"	"	"	"	ANCHORAGE ALASKA.	
	94 <sup>30</sup>	95 <sup>30</sup>	CQ	W6WZ	"	"	"	"	SAN DIEGO CALIF	SANDY.
9-23	82 <sup>30</sup>	-	CQ	—	"	"	"	"		
	83 <sup>30</sup>	84 <sup>30</sup>	KH6BIH	✓	14080	"	"	"	CAPTAIN COOK, HAWAII.	
	84 <sup>30</sup>	-	CQ	—	"	"	"	"	H.I., DAVE.	
	850	91 <sup>30</sup>	UA0AJ	✓	"	"	"	"	KRASNOYARSK, USSR	
									ALEX. ZONE 19.	





# W9cey

## LOG

OPR. *A. H. Mann.*

72

DATE	TIME EST	TIME GRT	STATION-CALLED	Called By	FREQ	STATION	PWR	ANT.	LOCATION	NAME
9-23	7 <sup>45</sup>	—	CQ	—	4080	<sup>A1</sup> <del>APL</del>	180	Beam		
	8 <sup>05</sup>	—	WA7NVR	—	"	"	"	"		
	9 <sup>05</sup>	9 <sup>15</sup>	UA0AJ	✓	14080	"	"	"	KRASNOYARSK, USSR	
								QSL	ZONE 19, ALEX.	
	9 <sup>25</sup>	—	UE6ATT	—	"	"	"	"		
	10 <sup>15</sup>	—	ZL4CA	—	"	"	"	"		
9-24	2 <sup>35</sup>	—	XE3W	—	"	"	"	"		
	2 <sup>45</sup>	2 <sup>55</sup>	CQ	W2GXE	"	"	"	"	ONEIDA CASTLE, N.Y.	
									GEORGE,	
	2 <sup>55</sup>	—	CQ	—	"	"	"	"		
	3 <sup>05</sup>	3 <sup>15</sup>	CQ	W5RSQ	"	"	"	"	MARSHALL, TEXAS, BOB.	
9-25	8 <sup>25</sup>	—	PN2BCA	—	4090	"	"	"		
	8 <sup>35</sup>	—	CQ	—	"	"	"	"		
9-30	7 <sup>55</sup>	7 <sup>57</sup>	CO	WB4ULL	14070	"	"	"	? LOST TO QRM.	
	7 <sup>59</sup>	—	VE2DEQ	✓	"	"	"	"		
	8 <sup>15</sup>	—	UA0AN	—	"	"	"	"	USSR,	
	8 <sup>35</sup>	—	PV7BIN	—	"	"	"	"	Recife Brazil, AYTTON	
	10 <sup>25</sup>	—	OA7BI	—	"	"	"	"	Maldonado, Peru	
	10 <sup>35</sup>	—	PY7AEN	—	"	"	"	"		
	10 <sup>35</sup>	—	CQ	—	"	"	"	"		





# W9Cey

## LOG

OPR. E. H. MORIN JR. 1972

DATE	TIME ON	TIME OFF	STATION CALLED	Called By	FREQ	QRM.	PWR	ANT.	LOCATION	NAME
10-2										
	609PM	-	CQ	-	21060	A1	180	DIPOL	-	-
	630P	-	K4GEE	-	21060	A1	180	DIPOL	-	-
	820P	-	G8SD	-	14090	"	"	BEAM	LONDON.	
	820	-	CQ	-						
	840	840	UA9HL	✓	14080	"	"	"	TOMSK, USSR	VICTOR.
	1135	-	CQ	-	"	"	"	"		
10-3										
	80P	820	CQ	K6GG	14080	"	"	"	WILLOWS, CAL	DICK.
10-4										
	1205A	1237A	XE1FFC	✓	14080	"	"	"	MEXICO CITY, MEXICO.	G10.
	1237	-	CQ	-	14080	"	"	"		
	1238	-	ZM2GH	-	"	"	"	"		
	1250A	-	H13PC	-	"	"	"	"	SANTIAGO, CHILE.	MARCO
	1157	-	CQ	-	"	"	"	"		
	435P	455	CQ	K7RDC	"	"	"	"	SUN CITY, ARIZONA.	BILL.
	518	-	CQ	-	"	"	"	"		
	840	-	UW9VC	-	"	"	"	"	NOVO KUSNETSK, USSR.	
	845	-	UV0AA	-	"	"	"	"	NOVOSIBIRSK, USSR.	
	9-10P	-	FG7TE	-	"	"	"	"	?	
	9-15P	-	UV0AA	-	"	"	"	"	NOVOSIBIRSK, USSR	
	925P	-	CQ	-	"	"	"	"		
	930		UA9HL	-	"	"	"	"	TOMSK, USSR	

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LOG

OPR. E.H. MORIN JR.

1972.

DATE	TIME ON	TIME OFF	STATION-CALLED	CALLED BY	FREQ	FT/M.	PWR.	ANT.	LOCATION	NAME.
10-5	640p	640p	UK12A	✓	14076	A1	180	80AM	MURMANSK, USSR	
	725	-	HK6KK	-	14080	"	"	"	ANATOL, PERTH, AUSTRALIA,	CUCIL
	740p	-	LH4KV	-	"	"	"	"		
	825	-	CQ	-	"	"	"	"		
	835	-	UA0AA	-	"	"	"	"		
	850	835	CP	W9SAL	"	"	"	"	CHONG COURT, ILL.	
	852	-	UA9HL	-	"	"	"	"		
	910p	-	UL7GAP	-	"	"	"	"		
	915	-	K4DMJ	-	"	"	"	"		
	920p	-	VE6ABQ	-	"	"	"	"		
	1030p	-	UL7PG	-	"	"	"	"		
	1045	-	CQ	-	"	"	"	"		
10-6	510p	-	YV1AVO	-	"	"	"	"		
	515	-	CQ	-	"	"	"	"		
	555p	-	JS2BSU	-	"	"	"	"		
	600p	-	XE1WU	-	"	"	"	"		
	705	740	CQ	W1KYK	14085	"	"	"	Providence, RI,	NORM
	745p	-	CQ	-	"	"	"	"		
	815	840	CQ	K4HSQ	7060	"	"	"	DIPole, Charlottesville, VA,	
	820p	-	CQ	-	"	"	"	"		
	940p	1020	CQ	WB4SQH/5	"	"	"	"	Corpus Christi, TEX,	LYLE
	1025	1030	CQ	W4TH1A	"	"	"	"	Port Townsend, WASH,	BRNIG
	1050p	-	CQ	-	"	"	"	"		





# W9CEY

## LOG

OPR. E.H. MORIN, JR.

1472

DATE	TIME ON	TIME OFF	STATION-CALLED	Called By	FREQ	GMA.	PWR.	ANT.	LOCATION	NAME.
10-6	1053	1108	XEIEH	✓	14080	A1	180	Beam	GUADALAHARA MEXICO.	ERIC.
10-7	645	-	CQ		7060	A1	180	DIPole.		
	708	718	WB4ALZ	✓	"	"	"	"	ANSLEY, ALABAMA.	FRANK.
	1048	-	CE3YG	-	14080	"	"	"		
	1058	-	CQ	-	"	"	"	"		
<del>10-10</del>	918	-	WA9KWS	-	3905	A3	"	"		
10/15	238		CQ	-	7258	"	"	"		
	245		CQ	W2SSH	7080	A1	"	"	Randolph N.Y.	Carl.
	738		CQ	-	14080	A1	"	"		
10-17	838		CQ	-	14060	"	"	"		
	848	918	WA3SKS	✓	14060	"	"	"	HASERTOWN MD.	DAVE.
10/20	858		CQ	-	"	"	"	"		
	928		LU9XP	-	"	"	"	"		
	918		CQ	-	"	"	"	"		
10-21	238		WA9KWS	-	7080	"	"	DIP.	SCH. 22.	
	338		CQ	-	"	"	"	"		
10-22	2248	2348	CQ	WA0RPIE	7080	"	"	DIP.	EDNA, IOWA	OTIS
	2448	2548	CQ	WB9A2D	"	"	"	"	VINCENNES IND.	AL.
	308	330	CQ	W2SSH	"	"	"	"	Randolph N.Y.	Carl.
	338	348	CQ	W9DOW	"	"	"	"	Sharon, WIS.	Pete.
	458	508	K4GWR/H	✓	14080	"	"	Beam	TAYLORSVILLE SC.	MIKE.

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## LOG

OPR. E.H. MORIN SR.

1972

Form 3220

DATE	TIME ON	TIME OFF	STATION-CALLED	Called By	FREQ	TEAM	PWR	ANT.	LOCATION	NAME
10-24	8 <sup>58</sup>		CQ	—	14070	A1	150	Beam		
	9 <sup>00</sup>		UW9VC	—	"	"	"	"		USSA
	9 <sup>10</sup>		HL7FSV	—	"	"	"	"		
	9 <sup>10</sup>		CQ	—						
10-25	10 <sup>45</sup>	7 <sup>00</sup>	CQ	WA1SPV	"	"	"	"	FALL RIVER, MASS.	A.R.T.
	7 <sup>00</sup>	—	PV1MCC	—	"	"	"	"		
	7 <sup>20</sup>	—	VE8RCS	—	"	"	"	"	ALERT, NW TERRA	A
	7 <sup>40</sup>	—	VE7BKE	—	"	"	"	"	—	
	8 <sup>00</sup>	—	CQ	—	"	"	"	"	—	
10-28	3 <sup>00</sup>	3 <sup>30</sup>	CQ	W3LWN/3	"	"	"	"	UPR.	RUSS
10-29	4 <sup>10</sup>	—	WA9RWS		7080	"	"	PIP		
	4 <sup>20</sup>	4 <sup>30</sup>	CQ	W3AVD	"	"	"	"	ORV.	
	4 <sup>30</sup>	—	CQ	—	14080	"	"	Beam		
	7 <sup>30</sup>	7 <sup>40</sup>	CQ	W6APW	"	"	"	"	SAN MARITO	WILL.
	7 <sup>40</sup>	8 <sup>00</sup>	CQ	XE3DA	"	"	"	"	CHAL.	
									MERIDA YUCATAN	JUAN
									NO ENGLISH - NO SPANISH.	MC XICO.
	8 <sup>30</sup>	—	CQ	—						
10-30	8 <sup>30</sup>	—	VE8RCS	—	14080	"	"	Beam	ALERT.	
	8 <sup>40</sup>	—	CQ	—	"	"	"	"		
	8 <sup>40</sup>	—	CQ	—	"	"	"	"		
11-4	9 <sup>00</sup>	—	WA9RWS		14080	"	"	"		
	9 <sup>15</sup>	—	WA9HWS		7080	"	"	"		
11-9	8 <sup>30</sup>	—	CQ	W9AHK	14080	"	"	"	MOBART, IND.	PAUL.
	8 <sup>40</sup>	—	CQ	—	"	"	"	"	—	



W9Cey

LOG

OPR. G.H. MORIN JR.

1972

DATE	TIME ON	TIME OFF	STATION-CALLED	Called by	FREQ	QRM.	PWR	ANT.	LOCATION	NAME
10-12	4 <sup>05</sup>	4 <sup>30</sup>	CQ	K4SU	14080	A1	180	Beam	Brandenburg, Virginia	Steve
10-18	9 <sup>30</sup>	9 <sup>45</sup>	CQ	W2KZN	"	"	"	"	Albany, N.Y.	Herb
11-19	2 <sup>00</sup>	2 <sup>15</sup>	WA9KWS	—	"	"	"	"	Baltimore	Pete
	2 <sup>15</sup>	2 <sup>40</sup>	"	—	7080	A1	"	DIPole	"	"
11-20	9 <sup>00</sup> pm	—	CQ	—	14080	"	"	Beam	—	—
11-21	10 <sup>30</sup>	10 <sup>40</sup>	CQ	WA3RMC	7080	"	"	DIPole	WAYNE, PA	PETE
	10 <sup>45</sup>	11 <sup>00</sup>	CQ	K6UYT	7080	"	"	"	LOS ANGELES, CALIF.	HAL
11-25	1 <sup>00</sup>	—	CQ	K4COR	14080	"	"	Beam	QRM	Cont.
	1 <sup>30</sup>	—	CQ	—	"	"	"	"	—	—
	1 <sup>20</sup>	—	K1RVP	—	"	"	"	"	—	—
	2 <sup>00</sup>	2 <sup>20</sup>	WA9KWS	—	14080	"	"	"	—	—
	2 <sup>00</sup>	2 <sup>40</sup>	"	—	7080	A	"	DIPole	—	—
	2 <sup>30</sup>	—	CQ	WAO ODY	"	"	"	"	SCOTSDALE, ARIZ.	FRANK
	6 <sup>30</sup>	—	PV2EVH	—	14080	"	"	Beam	—	—
	6 <sup>40</sup>	—	CQ	—	"	"	"	"	—	—
	6 <sup>50</sup>	—	CW3AA	—	"	"	"	"	—	—
11-26	3 <sup>35</sup>	—	CQ	—	14080	"	"	"	—	—
	3 <sup>38</sup>	—	K5WHL/5	—	"	"	"	"	—	—
	3 <sup>40</sup>	—	CQ	—	"	"	"	"	—	—
	4 <sup>00</sup>	4 <sup>15</sup>	K3JFV	—	"	"	"	"	Bedon P.A.	Gene
	7 <sup>42</sup>	—	WB4WFO	—	"	"	"	"	—	—
	7 <sup>43</sup>	8 <sup>00</sup>	CQ	WA4HBD	"	"	"	"	Peracola, FLA	Bill
	8 <sup>40</sup>	—	XE1EF	—	"	"	"	"	—	—
	8 <sup>50</sup>	9 <sup>00</sup>	CQ	W1GMB	"	"	"	"	Bedon N.H.	Fred





# W9cey

## LOG

OPR. E.H. MORIN JR.

1973

Form 5330

DATE	TIME EST	TIME OFT	STATION-CALLED	CALLED BY	FREQ	MODE	PWR	ANT.	LOCATION	NAME
5-8	840p		PI2BFD	✓	14080	A1	180	Beam		
	850p		CQ	W6WML	"	"	"	"	TEJUNGA, CALIF.	PAUL
	855	900	CQ	??	"	"	"	"	gsm	
5-17	90p		CQ	—	"	"	"	"		
	91p		KH6SIZ	—	"	"	"	"	Pearl Harbor	HAWAII
5-27	515p	545p	CQ	WB4DPK	"	"	"	"	Orlando FLA.	JOHN
	905p	92p	CQ	WB8NMP	"	"	"	"	PHILLIPS WVA.	BILL
	92p	—	CQ	—	"	"	"	"		
	100p	105	XE1SSU	✓	"	"	"	"	MEXICO, MEXICO.	
									JOSE,	
6-7	111p	113p	CQ	W7BWL	14100	A1	180	Beam	SUN VALLEY	DEWVIS
									INDIAHO.	
8-9-73	81p		CQ	—						
8-14-73	81p	82p	WAGHHQ	✓	14080	A1	180	Beam	SAN FRANCISCO	ERIC
"	83p		CQ	—						Page 16
8-27	45p	55p	CQ	WB0EBS	14080	A1	180	Beam	Leibing	Ray
									Colorado	
11-24	25p		CQ	—						
	22p	30p	CQ	W3JMI	14060	A1	180	Beam	Papawick PA	Low
	32p	33p	KV4PA	✓	14080	A1	180	Beam	ST. THOMAS	
									VIRGIN ISLANDS	DICK





# Wocey

## LOG

OPR. W. H. MORIN JR.

1972

DATE	TIME	STATION-CALLED	Called By	FREQ	MODE	PWR	ANT.	LOCATION	NAME
11-27									
11-28	730	LU5DOW	-	14080	A1	180	Beam	ARGENTINA	
	740	YL7CZ	-	"	"	"	"	ANCHORAGE ALASKA	
	800	CQ	-	"	"	"	"		
4-21	330	CQ		14080	A1	180	Beam (E)		
"	340	400 W7WV	✓	14085	A1	180	Beam (W)	SCOTT DALE, ARIZ.	HARRY
5-5	CST								
	1033P	CQ	-	14080	A1	180	Beam		
	1055P	ZL4CP	-	14080	A1	180	Beam		
	1055P 1110	ZL3FX	✓	14080	A1	180	Beam	CHRIST CHURCH NEW ZEALAND, 559	GEORGE
	CST.								
5-6	1225A	CQ	-	14080	A1	"	"		
	1240A	VK5QB	-	"	"	"	"		
	1245A	VK7GK	-	"	"	"	"		
	1250A	CQ	-	"	"	"	"		
	CDST.								
	740	WB6RGO	✓	21100	A1	100	DIPOLE	BELLMEAD, CALIF.	DEAN
	750	CQ	WB9EWW	7060	A1	100	DIPOLE	MUMFORD IN.	PETE
5-7	850	900 PY7B3X	✓	14080	A1	180	Beam	Recife, Brazil	Joel
	520	Both ways					SSB		
	920	930 CQ	UA9QAQ	14080	A1	180	Beam	KURANESTOK USSR	VLADAMIR
	940	CQ	W6HV	14080	A1	180		L.A. Calif.	Bill
5-8	800	CQ	-	14080	A1	180	Beam		
	810	YV2LL		"	"	"	"	SAN CRISTOBAL VENEZUELA	ALL
	820	840 CQ	K4APR	14080	A	180	Beam	LARGO, FLA.	GEORGE

2000

# Radio Frequency Interference: How to Find It and Fix It

## What is it?

**Radio-frequency interference (RFI)** or electromagnetic interference (EMI) can affect many types of electronic devices. Telephones are among the susceptible devices, possibly with anonymous "good buddies" **drowning out your conversations**, but RFI/EMI can also result in **unwanted interactions to television sets**, VCRs, a **garage-door opener** that opens or closes by itself, a **raucous buzz that drowns out AM broadcast stations**, **car engine stumble** or hesitation near radio towers, a **touch-controlled lamp with a mind of its own**, to cite just a few examples.

If you ever experience these, or similar problems, the book ***Radio Frequency Interference: How to Find It and Fix It*** will help. The **American Radio Relay League (ARRL)** (the national organization of Amateur Radio operators) has combined the work of numerous interference experts to help explain the solutions to your interference problems.

**Opening chapters explain how to: Locate help; Resolve conflicts; Identify interacting equipment.**

Other chapters discuss **RFI/EMI problems and cures for specific electronic systems:** Telephones; Stereos and other Audio Devices; Transmitters; Televisions (including VCRs and Cable TV); Power Lines and Electrical Devices; Computers; and Automobiles.

You'll also find explanations of RFI/EMI Regulations and Standards, the ARRL RFI/EMI Report Form and test reports on commercially built filters.

Interference problems are challenging, but they can be cured! Using the techniques described in this book, you can restore electronic peace in your home.

**Use the handy form below and order your copy today.** Contact Debra Jahnke at the American Radio Relay League headquarters for information about quantity purchases.

Rush my copy of ***RADIO FREQUENCY INTERFERENCE: How to find it and fix it.***  
**\$15 Plus \$3 Shipping and Handling ARRL Order No. 3754**

Name		Call	Payment enclosed [ <input type="checkbox"/> ]	
Street		Charge to: VISA [ <input type="checkbox"/> ]    MasterCard [ <input type="checkbox"/> ] Amex [ <input type="checkbox"/> ]    Discover [ <input type="checkbox"/> ]		
City	State	Zip		
Signature			Card Number	
			Expiration Date	

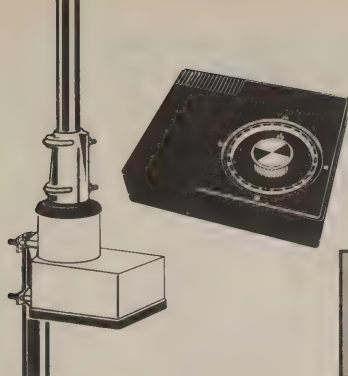


The American Radio Relay League  
225 Main St • Newington CT 06111 • USA  
(203) 666-1541









# ARCHEROTOR®

Catalog Number: 15-1225A

**CAUTION:** Read all of the **IMPORTANT SAFEGUARDS** contained elsewhere in this booklet, as well as all safety, installation and operating instructions supplied with this unit, and with your antenna, before installing or operating. Retain this booklet and all instructions for your safety and future reference.

## GENERAL DESCRIPTION

Your Archerotor is designed to turn and accurately position even the largest TV antennas, assuring the best possible TV picture reception. Rotation of the drive unit is synchronized with the position of the moving dot of the control unit. This is accomplished by use of highly accurate synchronous motors.

The connecting cable between the control unit and the drive unit carries only safe, low voltage power. When the operating cycle is complete, the unit shuts off automatically and draws no current until it is again activated by turning the control knob.

## INSTALLATION INSTRUCTIONS

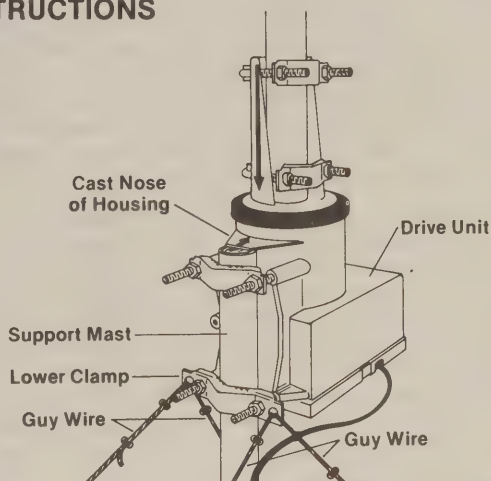
**IMPORTANT NOTE:** Before mounting drive unit on the support mast, connect drive unit to control unit with the control cable and perform the function shown in paragraph 7.

### 1 DRIVE UNIT MOUNTING

If not mounted inside a tower, attach the drive unit to the support mast by loosening the nuts enough to get the clamps over the mast. Lower the drive unit until the cast nose of the drive housing sits on top of the support mast and tighten the nuts. Moderate tightening of the nuts with a 7/16" wrench will cause the teeth to grip the mast securely. Do not overtighten to the point that you deform the mast, since this will reduce its strength.

Mast diameters of 1 1/4" to 2" (3-5cm) may be used. The 1 1/2" (3.8cm) size or larger is recommended for unguyed masts over 6' long, or where large antennas are used.

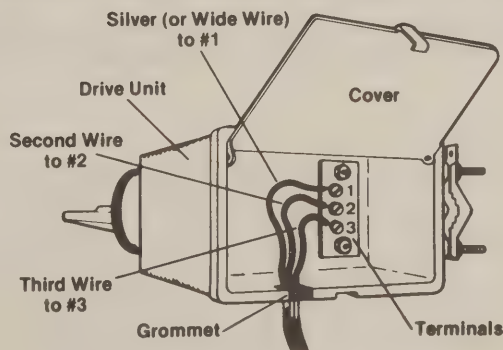
If guy wires are used, fasten two through each of the two holes of the lower clamp.



**CAUTION:** Select a mounting location where the antenna cannot come in contact with power lines while it is being installed, and where the installation will not fall across power lines if a guy wire should fail.

### 2 DRIVE UNIT CONNECTION

Up to 280' (84 m) of 20 AWG 3 conductor cable may be used. For longer runs, use heavier gage wire. To attach cable to the drive unit, snap open the cover using a coin or screw driver and connect the cable as shown. Remove the grommet and insert the cable thru the slot. Press the grommet back into the housing. Separate leads for 1 1/2" (4cm) and strip off the insulation for 1/2". Find the silver or wide jacketed lead and connect it to Terminal 1. Connect the adjacent lead to Terminal 2, and the next lead to Terminal 3. If 4 wire cable is used, connect both wire 3 and 4 to Terminal 3. Make sure there are no loose strands which can short between terminals. Recheck the wiring order and securely close the cover. *To avoid moisture collecting in the cable be sure jacket of cable passes thru the grommet.*



CUSTOM MANUFACTURED FOR

RADIO SHACK  A DIVISION OF TANDY CORPORATION

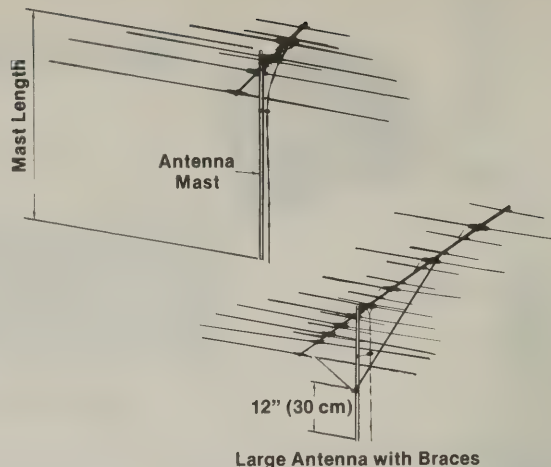
### 3 ANTENNA MAST

Antennas should be mounted close to the drive unit. Cut 1-1/4" (3cm) antenna mast to a length not exceeding that shown below and mount the antenna at the top of the mast. Attach transmission line to the antenna.

Antenna Size	Maximum Mast Length
Small (up to 5' (1,5 m) long)	5 feet (1,5 m)
Medium (up to 8' (2,4 m) long)	3 feet (0,9 m)
Large (over 8' (2,4 m) long)	2 feet (0,6 m)
Large with Braces	See Note
Two Antennas*	4 feet (1,2 m)

**Note:** Cut antenna mast 12" (30 cm) longer than distance needed to mount antenna and brace.

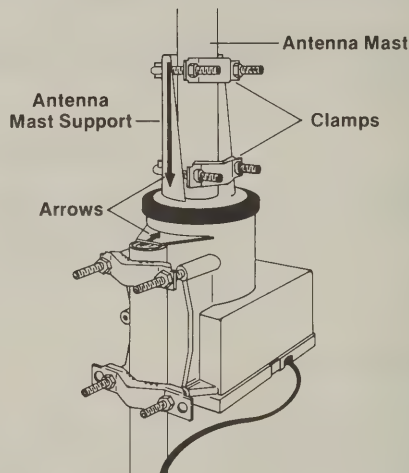
\* Mount small antenna at top, larger antenna 12" from bottom.



### 4 ANTENNA MOUNTING

The arrow of the antenna mast support and housing must be aligned. If not, turn the knob of the control until the arrow of the antenna mast support is in the position shown in the sketch. Loosen the clamps of the mast support enough to accept the antenna mast. Insert the antenna mast between the clamps and the mast support. The end of the antenna mast must sit on the bottom of the mast support. Rotate the antenna mast until the antenna points south, and tighten the nuts. *Excessive overtightening of the clamp nuts will weaken the antenna mast without adding any more clamping action.*

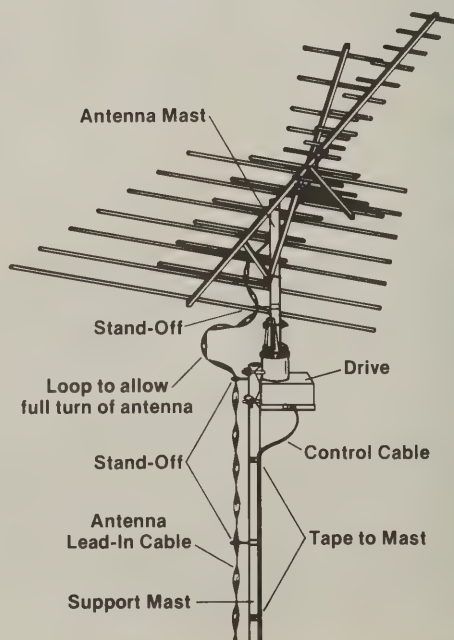
In some instances, where desired stations are predominantly in a northerly direction, it may be desirable to point the antenna north in order to avoid having the rotator operating near its end stops. If this is the case, point the antenna north instead of south when arrows are aligned. If this is done, please note that the antenna is pointing in the opposite direction from that indicated on the control. For example; When the control is pointing to North the antenna will be pointing South and when the control is pointing to East the antenna will be pointing West. Using channel markers as described in Step 9 will help to eliminate confusion.



### 5 CABLE INSTALLATION

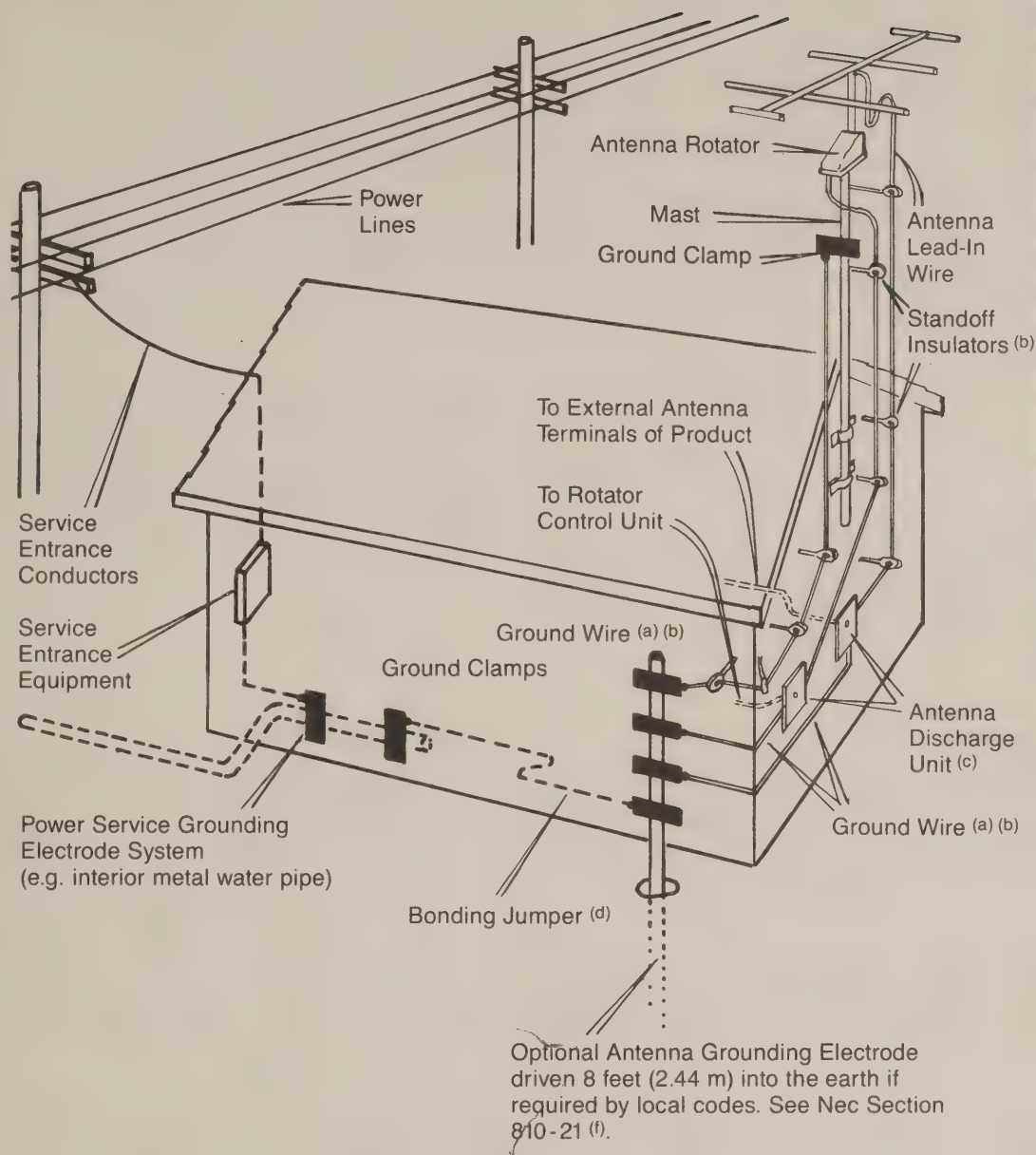
After connecting the antenna lead-in cable to the antenna fasten it to the antenna mast using stand-off insulators as shown. Provide a generous loop at the drive unit and attach lead-in cable to the support mast with stand-off insulators approximately every four feet. Tape the rotator control cable directly to the support mast.

**Note:** See Step 2 of the Important Safeguards Section for Grounding of Control Cable and Lead-in Cable for Lightning Protection.





# **Example of Antenna Grounding in Accordance with National Electrical Code Instructions**



- (a) Use No. 10 AWG (5.3 mm<sup>2</sup>) copper, No. 8 AWG (8.4 mm<sup>2</sup>) aluminum, No. 17 AWG (1.0 mm<sup>2</sup>) copper-clad steel or bronze wire, or larger, as a ground wire.
- (b) Secure antenna lead-in and ground-wires to house with stand-off insulators spaced from 4—6 feet (1.22—1.83 m) apart.

- (c) Mount antenna discharge units as close as possible to where lead-in and rotator wires enter house.
- (d) Use jumper wire not smaller than No. 6 AWG (13.3 mm<sup>2</sup>) copper, or the equivalent, when a separate antenna-grounding electrode is used.

# IMPORTANT SAFEGUARDS

Your antenna rotator unit, consisting of a control and a drive, has been engineered and manufactured to assure your personal safety, but improper installation or abuse of this unit, or the antenna connected to it, can result in potential electrical shock or fire hazards. In order not to defeat the safeguards incorporated in this unit, observe the following basic rules for its installation, use and servicing.

1. An outside antenna system should not be located in the vicinity of overhead power lines or other electric light or power circuits, or where it can fall into such power lines or circuits. When installing an outside antenna system, extreme care should be taken to keep from touching such power lines or circuits as contact with them might be fatal.
2. If the drive unit is installed on an outdoor antenna, be sure the antenna system is grounded so as to provide some protection against voltage surges and built-up static charges. Section 810 of the National Electrical Code, ANSI/NFPA70-1984, provides information with respect to proper grounding of the mast and supporting structure, grounding of the antenna lead-in wire and drive-unit to control-unit interconnecting cables to an antenna discharge unit, size of grounding conductors, location of antenna-discharge unit, connection to grounding electrodes, and requirements for the grounding electrode. See grounding code.
3. Your control is provided with ventilation openings to allow heat generated during operation to be released. If these openings are blocked, heat build-up can cause failure of the control and external damage. Therefore:
  - Never block the ventilation slots by placing it on a bed, sofa, rug, etc.;
  - Never place in a "built-in" enclosure unless proper ventilation is provided;
  - Never cover the openings with cloth or other material;
  - Never place near or over radiators, heat registers, amplifiers or other heat sources.
4. Your control may be equipped with a polarized AC line plug (one blade of the plug is wider than the other). This safety feature allows the plug to fit into the power outlet only one way. Should you be unable to insert the plug fully into the outlet, try reversing the plug. Should it still fail to fit, contact your electrician to replace your obsolete outlet. Do not defeat the safety purpose of the polarized plug.
5. Operate the control only from an A.C. power source as indicated on the bottom of the control. Do not use D.C.
6. Overloaded AC outlets and extension cords are dangerous, and so are frayed power cords and broken plugs. They may result in a shock or fire hazard. Unplug the control and call your service technician for replacement.
7. Do not allow anything to rest on or roll over the power cord, and do not place the control where power cord is subject to traffic or abuse. Pay particular attention to the cord at the plug and the point where it exits from the control unit. This may result in a shock or fire hazard.
8. All individuals, especially children, should be cautioned about dropping or pushing objects into any openings. Some internal parts carry hazardous voltages and contact can result in electrical shock. Objects dropped into the control may also result in a fire hazard.
9. Never expose the control to rain or water. If the control becomes damp or wet, or if liquids are spilled into it, unplug the control and have it inspected by a service technician before further use. Liquids, rain or excessive moisture may cause electrical shorts which can result in fire or shock hazards. Never operate the control near water; such as a swimming pool, etc. or near a bathtub, sink, laundry tub or in a wet basement.
10. Unplug the control before cleaning. Use a slightly damp (not wet) cloth. Do not use an aerosol directly on the control since it may over spray and cause electrical shock.
11. Whenever the unit exhibits distinct change in performance unplug the control and call your dealer or service technician.
12. Any attempt to disassemble the control or drive portions of this unit may expose you to high voltage or other hazards. Observe all cautionary labels, warnings and safeguards.
13. If the control has been dropped or the case has been damaged, fire and shock hazard may exist. Unplug the control and have it checked by a service technician before use.
14. When replacement parts are required, have the service technician verify that the replacements used have the same safety characteristics as the original parts. Unauthorized substitutions may result in a risk of fire or electric shock, or other risks.
15. Upon completion of any service or repairs to the unit, please ask the service technician to perform routine safety checks to determine that the unit is in a safe operating condition.
16. For added protection of the control during a lightning storm or when control is to be left unattended for an extended period of time, unplug it from the wall outlet and disconnect the rotator cable. This will prevent possible shock, fire hazard and damage to the control due to lightning storms or power line surges.
17. Always use extreme caution when installing a rooftop antenna and rotator system to reduce the risk of falls. Wear rubber-soled shoes and use a sturdy ladder. Do not install on a windy day or when the roof is wet or is covered with ice or snow.

## RADIO SHACK LIMITED WARRANTY

This equipment is warranted against defects for 90 days from date of purchase. Within this period, we will repair it without charge for parts and labor. Simply **bring your sales slip** as proof of purchase date to any Radio Shack store. Warranty does not cover transportation costs. Nor does it cover equipment subjected to misuse or accidental damage.

This Warranty gives you specific legal rights and you may also have other rights which vary from state to state.

*We Service What We Sell*

**RADIO SHACK**  **A DIVISION OF TANDY CORPORATION**

**U.S.A.: FORT WORTH, TEXAS 76102**  
**CANADA: BARRIE, ONTARIO L4M 4W5**

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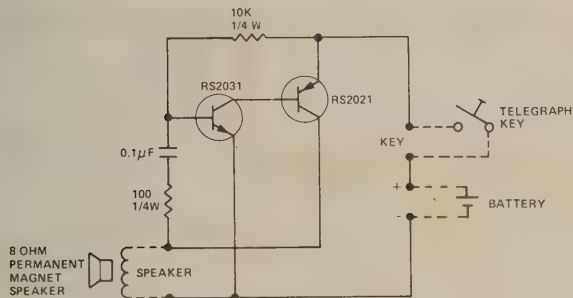
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# CODE OSCILLATOR MODULE

Catalog Number 20-1155

## INTRODUCTION

This Printed Circuit Board contains two transistors, two resistors and one capacitor which together form an oscillator circuit. You'll also need a small speaker, telegraph key and battery (all available at your Radio Shack store). After you have connected the parts according to these instructions, you'll be able to practice sending messages in Morse Code.



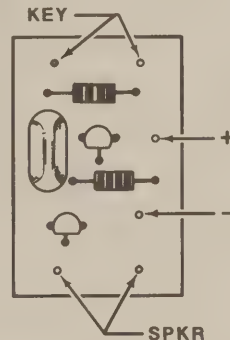
## HOOKUP AND OPERATING INSTRUCTIONS

- ☐ Connect the Telegraph Key to the solder pads marked "KEY".
- ☐ Connect the Speaker leads to the solder pads marked "SPKR".
- ☐ Connect the Battery leads to the solder pads marked "+" and "-". (Battery may be 1-1/2 to 9 volts.)

## CAUTION

Observe correct battery polarity (plus to +; minus to -) to avoid transistor damage.

- ☐ To operate, press and release the Telegraph Key.





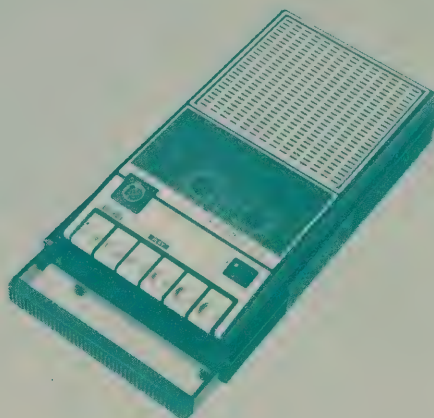


# USE AND CARE GUIDE



MODEL  
3-5105

## PORTABLE CASSETTE TAPE RECORDER MODEL 3-5105



GENERAL  ELECTRIC

READ INSTRUCTIONS THOROUGHLY BEFORE OPERATING

### CARE

The cabinet should be cleaned with a soft cloth dampened with water only. Never use a polish or strong cleaning agent on the cabinet, since some of these can damage its finish.

### WARNING

To prevent fire or electric shock hazard, do not expose this product to rain or moisture. Do not attempt to disassemble this cabinet. For service, always refer to a qualified serviceman.

As with any AC operated product, precautions should be observed during handling and use to prevent electrical shock. Electronic products of this type should not be immersed in water or used in bathing areas, when on AC power.

Extreme temperatures, such as found near a hot radiator, in a car when it's parked in the summer sun, may damage the cabinet or components in your unit. Always leave sufficient space around the unit for ventilation.

### IMPORTANT SAFETY INFORMATION

Should any repairs be required during the lifetime of your product, please ask the serviceman to verify that a SAFETY CHECK has been performed for continued safe operation.

### SERVICE

This product should be serviced only by those especially trained in appropriate servicing techniques. Competent service can be obtained from any General Electric authorized service facility (see WARRANTY). Attach your sales receipt to this booklet for future

reference or jot down the date this product was purchased or received as a gift. This information will be valuable if service should be required during the warranty period.

Purchase Date .....

Name of Store .....

### GENERAL ELECTRIC COMPANY FULL NINETY DAY WARRANTY

General Electric Company warrants this product to be free of manufacturing defects for a 90 day period after the original date of consumer purchase or receipt as a gift. This warranty does not include damage to the product resulting from accident or misuse.

If the product should become defective within the warranty period, we will elect to repair or replace it free of charge, including free return transportation, provided it is delivered prepaid to any General Electric authorized service facility. There is a nationwide network of authorized service facilities whose names and addresses are included with this product. Any questions regarding warranty service (or out of warranty service) can be directed to: Manager — Consumer Services, General Electric Company, Audio Electronics Products Department, Building #5, Electronics Park, Syracuse, New York 13221.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

GENERAL  ELECTRIC

Model 3-5105G  
299A5125 (Rev. 1)  
78-44

Printed in Korea

## FROM GENERAL ELECTRIC . . .

a portable cassette tape recorder . . . includes a built-in condenser microphone, erase plug storage, pause control, automatic level control (ALC) and automatic end of tape shut-off.

Before operating, please read the following instructions.

## PRELIMINARY SET-UP

**AC/DC POWER:** This AC/DC power recorder operates on AC household power, 5 "C" size batteries (not included), or with the optional Car Adapter.

## BATTERY OPERATION

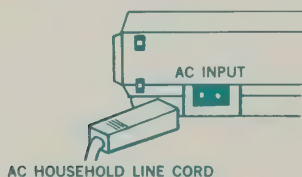
1. Remove battery compartment door located on cabinet bottom, by pushing latch in direction of arrow and lift door off the unit.
2. Insert 5 "C" size flashlight batteries into battery compartment. Be sure the (+) or cap ends of each battery are installed as shown in the battery compartment.
3. Replace battery door.

**IMPORTANT:** Be sure to remove the batteries when storing the set for more than a few weeks at a time. Leaky batteries can badly damage the recorder. Always push STOP button before storing. This will relieve pressure on certain parts in the recorder that might deform after long periods of time.

**NOTE:** If the recorder begins to sound distorted or has poor tone quality, or if the tape reels turn very slowly or not at all, be sure to check with a new set of batteries or another cassette before seeking service.

## AC POWER OPERATION

Plug one end of the AC line cord into the "AC input" jack on the rear of the set, and the other end of line cord into AC household outlet. The voltage converter is built into the set. Plugging the AC line cord into the set automatically disconnects batteries internally.



AC HOUSEHOLD LINE CORD

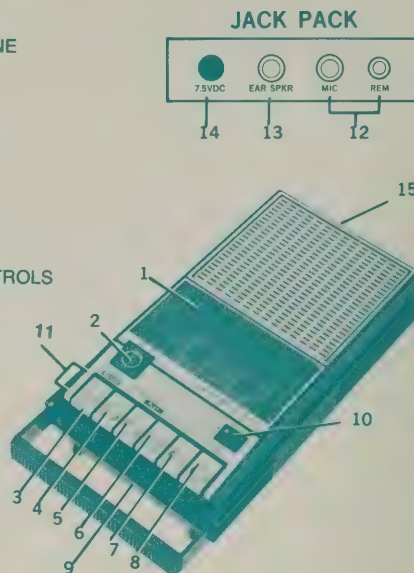
## CAR ADAPTER RT9508 — OPTIONAL

This recorder may also be operated from a cigarette lighter socket in your car. The optional accessory adapter plugs into the "7.5V DC" jack on the side of the set (which automatically disconnects the batteries), and into the cigarette lighter socket of your car.

Some Adapters provide 2-position switch (6 or 7.5V) and must be set to 7.5-volt position.

## CONTROLS

1. CASSETTE DOOR
2. CONDENSER MICROPHONE
3. RECORD BUTTON
4. REWIND (REW)
5. PLAY
6. FAST FORWARD (F-FWD)
7. STOP
8. EJECT
9. ERASE PLUG STORAGE
10. PAUSE CONTROL
11. VOLUME AND TONE CONTROLS
12. MICROPHONE/REMOTE 3.5/2.5MM JACKS
13. EARPHONE/SPEAKER 3.5MM JACK
14. 7.5 VOLT DC JACK
15. 120V AC POWER JACK

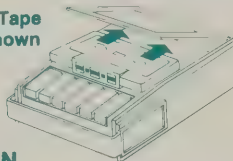


## CASSETTE INSERTION

1. Press the STOP button if any of the buttons are depressed.
2. Press the EJECT button to open the cassette compartment door. An internal interlock prevents the cassette compartment door from opening unless all controls are in the "OFF" or "UP" position.
3. Insert the cassette in the compartment with the full reel of the tape at the left and the exposed tape facing you. Then close CASSETTE DOOR.

The tape movement for normal play and record operations is from left to right.

Face Tape  
As Shown



## BUILT-IN MICROPHONE RECORDING

- With cassette inserted, depress the RECORD and PLAY buttons simultaneously.  
**NOTE:** If the record button will not depress, you may not have cassette inserted or it's a prerecorded cassette, see section "Prevent Accidental Erasure."
- Talk normally into the BUILT-IN CONDENSER MICROPHONE located on cabinet top. To obtain optimum recording quality, place the recorder with the microphone freely exposed to sound source and as close as convenient.

**NOTE:** The Automatic Level Control (ALC) will set the record level for optimum recordings, regardless of volume control setting.

- When you finish recording, press the STOP button.

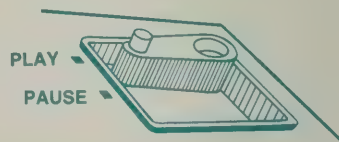
## REMOTE MICROPHONE RECORDING

To record with a remote microphone, plug the microphone into the MIC jacks and follow the Built-in microphone recording instructions.

To stop the recording temporarily, slide the ON-OFF switch located in the microphone to OFF. When the remote microphone is used, the built-in microphone is automatically disconnected.

## PAUSE CONTROL

Your recorder is equipped with a convenient PAUSE CONTROL which will stop the machine in either PLAY, RECORD or REWIND modes, as long as the PAUSE CONTROL is set to the PAUSE position.



## REWIND

To turn the tape back to the beginning of your recording, simply push the REWIND button. Watch the tape through the window in the cassette door. Push the STOP button when you have rewound the desired amount.

## AUTOMATIC STOP

When your recorder is operating in the PLAY or RECORD modes and the end of the tape is reached, your unit will automatically shut itself off and return the buttons to the off position. The unit does not automatically shut-off in Rewind mode.



## PLAYBACK

To listen to your recorded tape cassettes, just push the PLAY button and adjust the VOLUME and TONE to desired listening level and taste.

## FAST FORWARD (F-FWD)

To skip over portions of the tape quickly, press the F-FWD button, release button when desired position is reached. This control is especially designed to be non-latching and used for editing.

## PREVENT ACCIDENTAL ERASURE

Every time you make a recording, any previous recording on the tape is automatically erased. When you have a recording you want to keep permanently, break out the rear left tab of the side you want to save as shown in the following illustration:

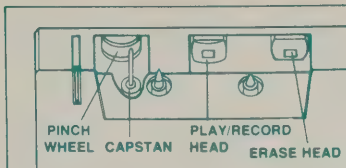


When a cassette with the tab broken out is inserted in the tape unit, accidental erasure is prevented by a lever in the mechanism that keeps the REC Button lever from depressing. Cellophane tape can be placed over the opening later on, if you decide to record over original recording. Similarly, you can record over purchased prerecorded cassettes.

**PLEASE NOTE:** Your machine is equipped with a cassette sensing mechanism. This mechanism prevents RECORD button from being depressed when cassette is not in unit.

## CLEANING THE HEADS

Iron oxide particles from the magnetic tape will, in time, build up on the parts that come into direct contact with the tape. These deposits can sometimes cause premature automatic stop of the tape or cause incomplete erasure and a sort of "muffled" sound during playback.



Clean areas indicated after every 40 hours of use.

With the cassette door open and the PLAY button pushed down; the parts indicated can be cleaned (gently) with the optional head cleaner in Tape Care Kit No. 5-1715. Always unplug the AC power cord and allow 30 minutes drying time.

Another convenient method is to use the optional cassette head cleaning tape, No. 5-1108.

## IN CASE OF DIFFICULTY

1. Go back through the instructions to make sure you haven't omitted something.
2. Check the batteries — they could be in backwards, weak, dead, or not making contact. Replace batteries if unit is OK on AC operation.
3. When using the remote microphone, is the switch in the "ON" position?
4. Muffled sound? Do the heads need cleaning?
5. Won't go into Record? Tabs on cassette may be punched out.
6. Bad cassette? Try a known good one.
7. Premature automatic shutoff? Bound or tight tape — try a known good cassette.
8. Is PAUSE control in "PLAY" position?

## TAPE ERASE

There are two ways to erase unwanted recording material:

- A. The first method is to record over the unwanted recording. This replaces the unwanted recording with a new recording.
- B. To erase the tape completely, and return the tape to a blank condition use the optional TAPE ERASE plug 5-1804 as follows:
  1. Insert the erase plug into the large (3.5mm) "MIC" jack located on the unit.
  2. Insert the cassette you wish to erase.
  3. Press the RECORD and PLAY buttons simultaneously, as you would if you were making a recording. You are now erasing the tape. When you have erased the entire tape, your recorder will shut off automatically, REMOVE ERASE PLUG and return it to the storage area located on CABINET BOTTOM under the carry handle.

## PATCHCORD — NO. 5-1051

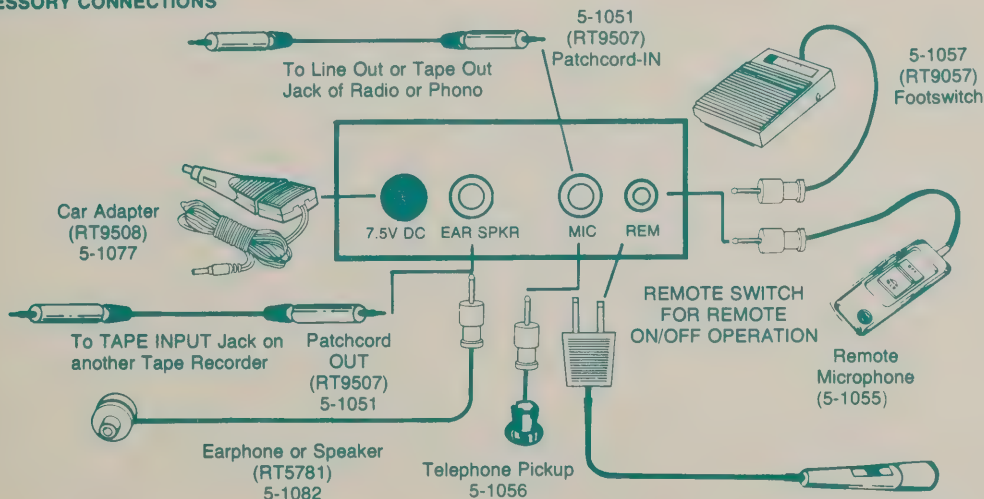
The optional patchcord kit makes it possible to record direct from most radios, other tape machines or phonographs. The patchcord may be used to duplicate your favorite selections on another tape recorder. (Kit includes complete instructions).

To record from a stereo unit, you will also need a "Y" adapter No. 5-1705.

## EARPHONE 5-1082

The optional earphone No. 5-1082 plugs into the EAR jack on your set. With the earphone plugged in, the speaker is automatically silenced for private listening. Your set is also equipped with EARPHONE MONITOR capability when recording direct from other sound sources, such as other tape recorders, radios or phonographs (refer to PATCHCORD section this page). Simply plug into the "ear" jack and you can monitor (listen to) what is being recorded on your set. The earphone (3.5mm) jack may also be used for an 8 ohm extension speaker.

## ACCESSORY CONNECTIONS

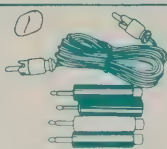


## OPTIONAL ACCESSORIES

Your General Electric tape recorder is a highly versatile piece of equipment. It can be used for work, for play, for letter-writing, and numerous other things. These accessories will let you take full advantage of that versatility and help you maintain your recorder in tip-top shape. Some of the items may be available at your General Electric dealer or you may order directly from the factory (General Electric Co., P.O. Box 1020, Utica, N.Y. 13501) by using the convenient attached tear-off form.

*also 1 cassette winders + 1 tape erase plug ordered 3-8-83*  
*H.E. Audio Electronics Prod. Dept. P.O. Box 1020 Utica N.Y. 13501*

### EXTERNAL POWER AND RECORDING ACCESSORIES



#### PATCHCORD KIT

Record (patch) directly from many radios, tape machines, or phonographs to your tape recorder. Eliminate background noise normally encountered with microphone recordings. Use with monaural GE products and many other brands that have 3.5mm or phono type input or output jacks. Kit includes six-foot cord, four adapters, instructions.

No. 5-1051

\$6.95



#### "Y" ADAPTER (PHONO)

Flexible "Y" adapter, one end phono type jack, other end phono type plugs. Use with patchcord kit 5-1051 to make monaural tape recordings from stereo units with phono-type speaker or output jacks.

No. 5-1705

\$2.49



#### DYNAMIC PENCIL MICROPHONE

A deluxe remote control pencil mike with outstanding performance. With off-on switch, 2.5, 3.5mm jacks, and desk stand. Black and silver finish.

No. 5-1055

\$7.95

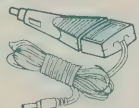


#### TELEPHONE PICK-UP

No wiring required, suction cup attaches to phone receiver. Amplify or record conversation with the sensitive "mike". Has miniature (3.5mm) phone plug to fit all GE tape recorders.

No. 5-1056

\$2.95



#### CAR ADAPTER

Save your precious batteries until you really need them. Adapter plugs into cigarette lighter and powers tape recorder from your car.

**Caution:** Use of improper adapter will result in damage to your recorder or player.

No. 5-1077 GE tape recorders using 4' or 5 batteries.

\$8.95



#### FOOT SWITCH

When you need your hands free for writing, the remote foot switch can be used to temporarily stop record and playback without resetting buttons. May be used with all GE portable tape recorders. Plugs into small (2.5mm) "Mic" jack.

No. 5-1057

\$6.95

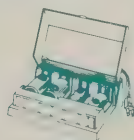


#### REMOTE SWITCH

Makes dictating a snap! Allows you to stop and start your cassette machine while recording or playing without resetting buttons or T-bar control. Hand contoured design has large, positive Off-Talk switch. Compatible with all G.E. recorders as well as many other brands. Plugs in "REM" 2.5mm jack.

No. 5-1060

\$4.95



#### RECHARGEABLE BATTERY KIT

GE's Perma-cell® rechargeable battery system saves you money because you can recharge each battery 1000 times. You use these batteries just like throw-away batteries, except for throwing them away! After each use, you just recharge them to full capacity. At 1000 uses, it costs less than a penny each time you use a battery. Kit includes 6 rechargeable "C" batteries and charger unit.

No. 5-1701/5-1703

\$29.95

### FOR THE ADDED DIMENSION OF PRIVATE LISTENING



#### STEREO HEADPHONE

For the ultimate in listening enjoyment, use GE's quality stereo headphone. Equipped with a 1/4" stereo phone plug ready for use with your 8-track tape player or stereo system. Used with Headphone adapter, 5-1277, can be connected to your monaural GE tape recorder and many radios, phonos and TV's equipped with earphone jacks.

No. 5-1300

\$21.95



#### STEREO HEADPHONE ADAPTER

Enables you to use stereo headphones with your scanner, monaural tape recorder, and any radio, phono, TV, etc. having a 3.5mm (ear) jack. Use with stereo headphones 5-1300. Unlike earphones, the headphone pads block out external noise.

No. 5-1277

\$3.25

#### TRANSCRIPTION HEADPHONE

Ideal for office dictation or private listening. Fits all G.E. Cassette Tape Recorders with a 3.5mm "ear" jack. Use with foot switch, 5-1057 for a fine low-cost transcription package.

No. 5-1709

\$8.95



Chin type, will not disturb hair style.



#### PILLOW SPEAKER

Quality sound at listening levels that assure you of not disturbing others in the room — even in the same bed. Use with any G.E. tape recorder plus many TV, phonos, radios with 3.5mm earphone jacks.

No. 5-1708

\$3.95

#### EARPHONE

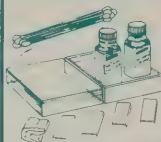


For all General Electric tape recorders. With earphone plugged into 3.5mm earjack, speaker is automatically silenced for private listening.

No. 5-1082

\$1.50

### MAINTAIN YOUR TAPE EQUIPMENT LIKE NEW



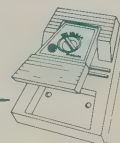
#### TAPE CARE KIT

Use with all tape recorders and players.

Removes and prevents build-up of harmful dust and oxide deposits on heads, capstan, and pinch rollers. Includes one bottle of cleaner and lubricant, several long Kleen Stix, tape cleaning cloth, and 58-tr. cartridge dust guards.

No. 5-1715

\$4.95



#### TAPE SPLICER

Splices, edits and repairs recording tapes in just seconds. Built-in tray to hold splicing patches.

5-1717 — for cassettes - 1/2"

\$4.95

#### SPlicing PATCHES

5-1718 — for cassette tape (approx. 100)

\$1.49



#### CASSETTE WINDERS

Great for editing and repair. Winds cassette tape in either direction. Take up slack in loose cassettes.

No. 5-1720 (2 per pkg.)

\$1.29

#### BATTERY DOOR REPLACEMENT

\$2.50

**Scotch**

\*REGISTERED TRADEMARK OF 3M CORP

#### CASSETTES



**Highlander® Low Noise** - Record it, and know you've got it. That's what you can say about this cassette that offers dependability not commonly associated with absolute economy. At home, at school, or on the move — you will be happy with both the price and the performance.

CAT. NO.	DESCRIPTION	PRICE
5-1113	HC-45 (45 min.)	\$1.39
5-1101	HC-60 (60 min.)	1.59
5-1114	HC-90 (90 min.)	2.39
5-1115	HC-120 (120 min.)	3.79



**Low Noise/DynaRange®** - This is the high quality cassette for every recording application. Excellent for music, fine for speech. It is normally compared with the premium quality line of other brands. It is surpassed in quality only by the "Scotch" Master cassette.

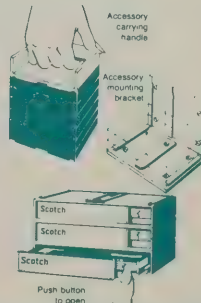
CAT. NO.	DESCRIPTION	PRICE
5-1102	SC-60 (60 min.)	\$2.59
5-1103	SC-90 (90 min.)	3.69
5-1104	SC-120 (120 min.)	5.19

**Master Cassettes** - The completely new high-performance medium priced cassette. Master has these quality features:

- Improved high frequency output
- Bias and equalization compatible with all cassette recorders
- Posi-track backing for smooth precise tape winds 60, 90 and 120 minute playing time.



CAT. NO.	DESCRIPTION	PRICE
*5-1110	MC-60CB* (60 min.)	\$3.59
*5-1111	MC-90CB* (90 min.)	4.59
5-1112	MC-120 (120 min.)	5.79



#### • HEADCLEANERS

#### • 3M TAPE ACCESSORIES

**The C-Box Storage System** - A new pushbutton storage container.

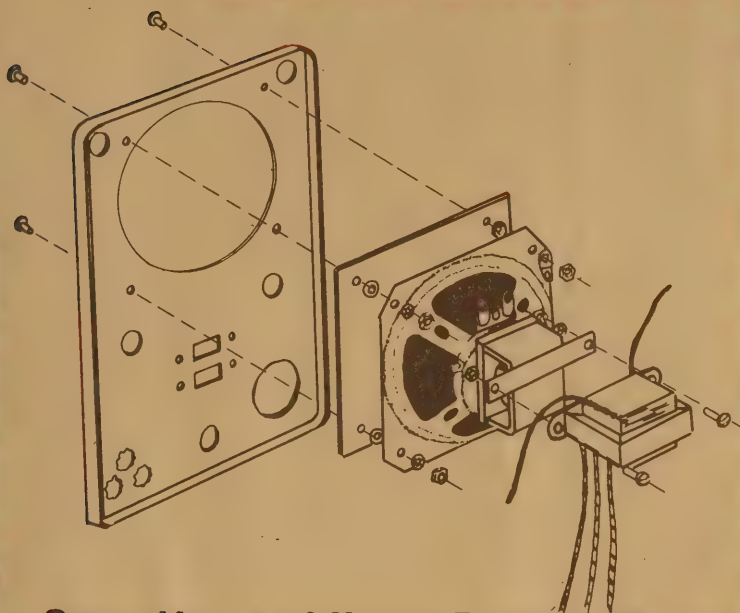
- Cassette drawers snap open and shut.
- Stackable. Tops and bottoms interlock to form a single, solid storage system.
- Accessory items include 3 empty C-Boxes, mounting bracket and carrying handle.

CAT. NO.	DESCRIPTION	PRICE
5-1130	C-Box 3 Pack	\$2.49
5-1131	C-Box Wall Bracket	1.69
5-1132	C-Box Handles	1.69
<b>HEADCLEANER</b>		
5-1108	Cassette Head Cleaner	\$1.89



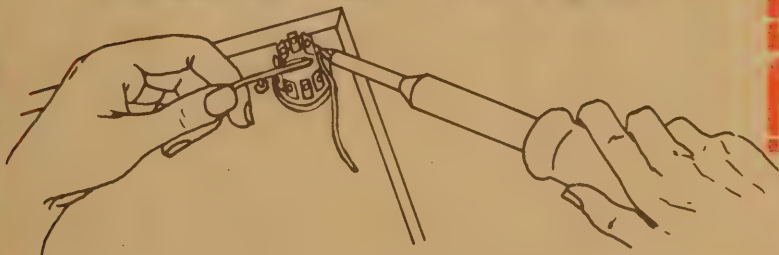
advance schools, inc.

asi



Operation and Home Project Manual

# SIGNAL TRACER



**Kit No. K-107**

5900 NORTHWEST HIGHWAY

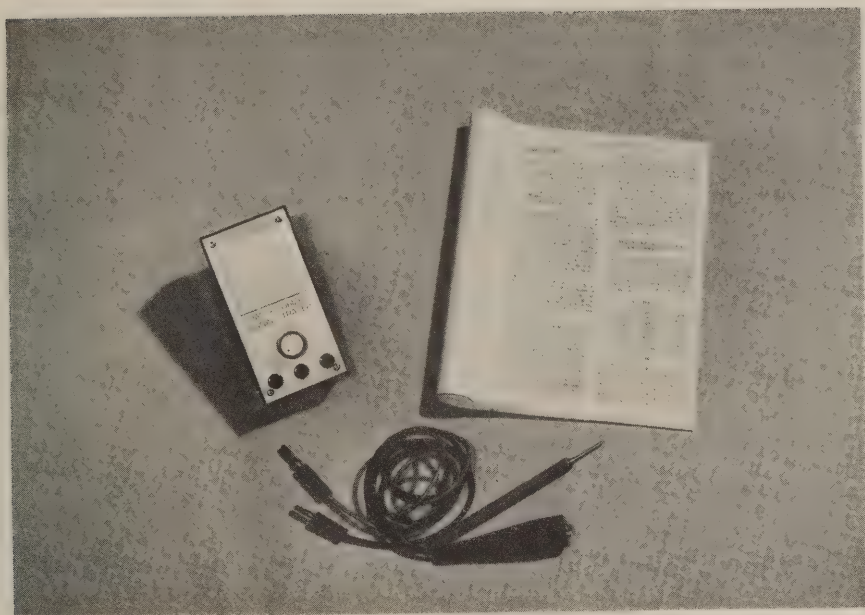
CHICAGO, ILLINOIS 60631



© Advance Schools, Inc. 1972

Revised 1973

Reprinted July 1974



## ASI SIGNAL TRACER

### SPECIFICATIONS

Transistor Component:	2SB176, 2SB175, 2SD32 x 2 MT-250 Thermister
Input Impedance:	AF: 30,000 Ohms (Approx.) RF: 50,000 Ohms (Approx.)
Output:	2" 8 Ohm Speaker
Power Supply:	9 Volt Battery

### TRANSISTORIZED SIGNAL TRACER

The ASI Signal Tracer is designed for use by technicians, servicemen and amateurs for ease in localizing troubles. This instrument permits audible signal tracing of RF, IF and audio circuits. It is designed for easy stage by stage tracing of the signal from antenna to the speaker. It serves as a useful amplifier for checking microphones and record players.

## USING THE SIGNAL TRACER

The ASI Signal Tracer is one of the most effective instruments the serviceman can use for rapid, trouble-shooting in radio and TV circuits.

This tracer features a number of useful applications which will enable the service technician to quickly locate and diagnose the trouble in the circuit under test. Many of the tests will be performed automatically, and will require only a few seconds of the technician's time. It is suggested however, that the user familiarize himself with the instrument's operation, so that maximum benefit can be realized.

The procedures to be followed when using the Signal Tracer are outlined in a general manner only, and do not represent the limits of its applications. Each individual will develop his own procedures and applications by using the instrument.

### CHECKING RF AND IF CIRCUITS

To check for trouble in RF or IF circuits, simply connect the test lead to the terminal marked COM., and the other end to the chassis or the ground of the unit to be tested. Insert the other cable into the RF jack and check the receiver under test by moving the alligator clip from stage to stage (from antenna to converter to IF section).

### AUDIO SIGNAL TRACING

After detection has taken place in the receiver, the use of the RF lead is not required and the lead should be plugged into the AF outlet. From the detector stage the signal can be traced through the various coupling circuits, through the audio and output stage and the output transformer. These tests can be made quickly and easily and any circuit fault would be indicated by a loss of gain or signal in succeeding stages. Intermittent or faulty volume controls and coupling condensers can also be quickly spotted. When using the tracer keep in mind that the Signal Tracer will detect the presence as well as the absence of signal.

As a signal is traced through the audio system the signal level will be extremely high, and it will be necessary to reduce the setting of the signal tracer gain control. A definite reduction in gain will be noted as the lead is moved from the primary to the secondary of the output transformer. This is normal and is due to difference in the turns ratio and impedance of the windings in the transformer.

### AUDIO SYSTEM

Quite frequently the service technician will be called upon to service automatic record-changers or phono mechanisms. Of course, this equipment is usually removed from the cabinet of the receiver and transported to the service shop. On making mechanical



repairs or adjustment on the changer mechanism, it is frequently desirable that the output of the phono cartridge be checked and actual conditions of tone reproduction simulated. Here again, it is a relatively simple matter to connect the audio input of the Signal Tracer to the output cable of the record changer. The changer output as heard in the speaker of the tracer will permit detection of any irregularity in mechanical operation, such as turn-table wow or thump, or any objectional noise that could be transmitted through the phono cartridge and reproduced as an undesirable condition.

This same procedure could be used in checking microphones and musical instrument pickups, and here again the results obtained are interpreted on the basis of comparison made with previous tests on similar equipment. This signal tracer can be used in checking FM tuners or other equipment requiring the use of an audio system.

## OUTPUT LEVEL

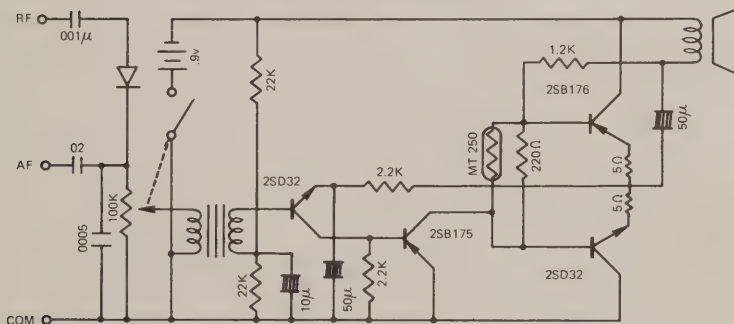
While performing alignment adjustments, the amount of gain or loss experienced in following a specific alignment procedure can quickly be determined by the level of the audio signal. The ASI Signal Tracer will prove itself an extremely useful and versatile addition to any service shop. It is earnestly suggested that the user thoroughly familiarize himself with all phases of its operations, so that he may obtain maximum benefit from his investment in this instrument.

## LAB EXPERIMENTS

To use the Signal Tracer for RF signal tracing, the probe lead should be plugged into the RF output, the off-on switch to the ON position. The level control should be adjusted as needed.

NOTE: At near maximum settings of the level control a certain amount of hum will be present; this is due to the high sensitivity of the unit.

### CIRCUIT DIAGRAM



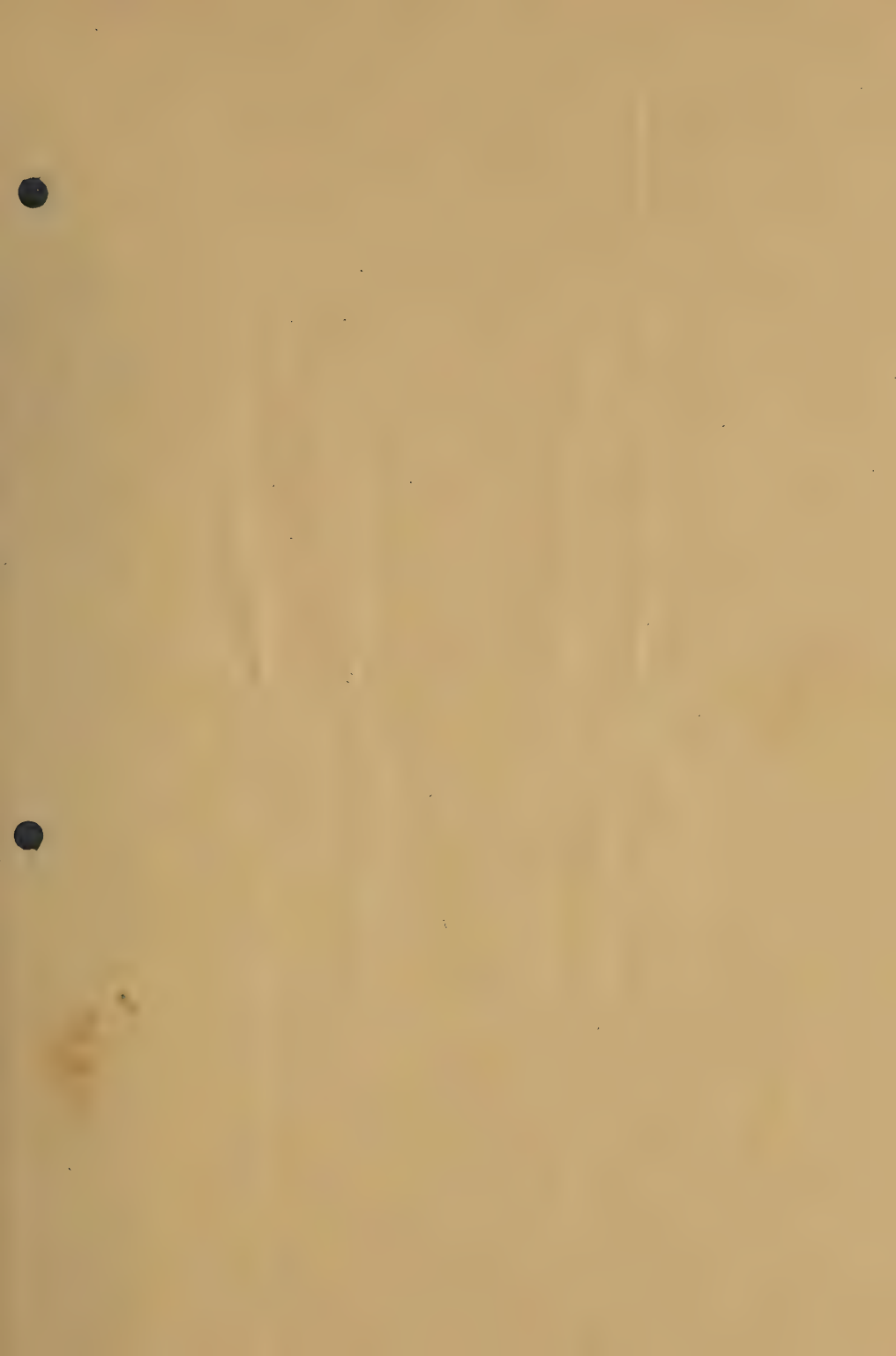
To illustrate the use of this instrument, let us assume that the receiver under test has a specific complaint of low volume. Since the receiver is in partial operating condition, it could be turned on and tuned to a familiar station. The volume control should be turned down so that the speaker output will not interfere with the signal tracer results. The ground lead of the probe should be clipped to the B- or ground circuit of the receiver.

If the receiver is tuned to a strong station, and the lead connected, a signal should be present at the loop antenna and the tuning condenser. The signal at the mixer or converter plate is very weak and requires a high gain setting of the tracer. This condition may result in hearing a high hum level in the tracer when the lead is connected to the plate. On some receivers the hum over-rides the signal making it necessary to move the lead to the secondary of the input IF transformer, in order to check the gain of the first stage, or the use of a shielded lead on the tracer.

The path of the signal can be traced through any succeeding IF stages to the detector. During these tests an approximate estimation of gain per stage can be made. The amount of gain that can be expected in a circuit can best be determined by previous experience in making similar tests.

In some cases the RF lead causes a slight detuning effect when applied to tuned circuits. In these cases advance the lead to the following test point, and if a good signal is present it would be reasonable to assume that the preceding circuit is functioning properly.

The same general procedure may be used in checking RF and IF stages in FM and TV circuits. Since the actual signal is the prime factor of consideration, the signal tracer will detect the presence or absence of said signal regardless of the type of circuit involved.





902

CHICAGO  
NO. 107-6547  
CHICAGO, ILL. 60640

(3-2) 44-6500

IN LOVING REMEMBRANCE OF

**EARL HOWARD MORIN**

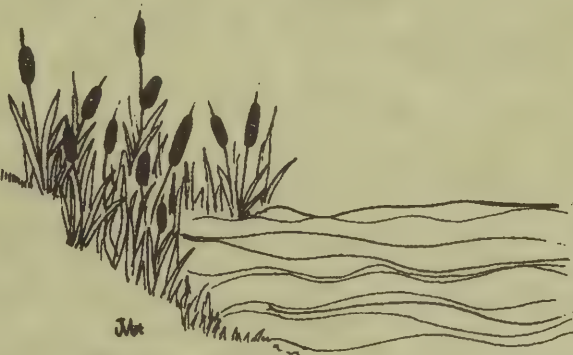
*Born into This World:  
Called into Eternal Life:*

*March 6, 1923  
December 5, 2006*



***“For my part,  
I have fought the good fight,  
I have finished the race,  
I have kept the faith.”***

*St. Paul's letter to Timothy*









***HERE I AM, LORD***

I, the Lord of sea and sky,  
I have heard my people cry.  
All who dwell in dark and sin my hand will save.  
I who made the stars of night,  
I will make their darkness bright.  
Who will bear my light to them? Whom shall I send?

***Here I am Lord, Is it I, Lord?  
I have heard you calling in the night.  
I will go, Lord, if you lead me.  
I will hold your people in my heart.***

I, the Lord of snow and rain,  
I have borne my people's pain.  
I have wept for love of them. They turn away.  
I will break their hearts of stone,  
give them hearts for love alone.  
I will speak my word to them. Whom shall I send?

I, the Lord of wind and flame,  
I will tend the poor and lame.  
I will set a feast for them. My hand will save.  
Finest bread I will provide  
till their hearts be satisfied.  
I will give my life to them. Whom shall I send?

Text: Isaiah 6; Dan Schutte. b.1947

Tune: Dan Schutte, b.1947; arr. By Michael Pope, SJ, John Weissrock

Copyright 1981, Daniel L. Schutte and New Dawn Music



## **SHEPHERD ME, O GOD**

*Shepherd me, O God beyond my wants,  
beyond my fears, from death into life.*

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### **PRAYER OF THE FAITHFUL**

*We continue to pray this morning for Howie, a faith filled man who treasured his faith, practiced it well, and whose life among us ended so suddenly. May our God, the God of all life now embrace him and say those consoling words, "Well done, good and faithful servant. Come now and share my joy." We pray to the Lord...*

**PLEASE RESPOND: LORD, HEAR OUR PRAYER**

*We pray in gratitude for Howie's life and for all the gifts he shared with us as a most loving and caring son, brother, husband, father, grandfather, great-grandfather, and uncle, whose family always came first in his affection and concern; for all his pride and joy in his children and then those who followed, always being interested in all their activities and events; for all his hard work and his special talents which he used and developed in so many ways; for his technical and artistic gifts which he expressed in his numerous drawings and wood carvings which he gave as gifts to many; for his creative abilities inventing many things including videotape, canopy strollers, making furniture, weather and radio instruments, and a telescope; for his being a "Mr. Fix It" par excellence knowing how to do all things including electrical and plumbing, even to building a house; for his dedicated service as a sailor in the United States Navy serving in the Pacific during World War II; for his great enjoyment fishing, doing yard work, and being a "Ham Operator"; for his commitment to Catholic education providing this for all his children; and for his good sense of humor, which always made him so enjoyable to be around; for his pleasure having a good steak, orange juice, and rolls with gravy; and for all his strength and courage in facing the challenges of his life. May these gifts and all those other unmentioned ones now continue to live on in his family and friends and be shared with others. We pray to the Lord...*

**PLEASE RESPOND: LORD, HEAR OUR PRAYER**

*We pray for Howie's dear wife of sixty years Doris, his children and their spouses Mary; Dan; Peter; Paul and Maureen; Jane; Tom; Beth and Darin; his grandchildren Andy Ben; Charlie; Nick; Jon; Alex; Sam; and Megan; his great-granddaughter Meredyth; his brother Jack; his sisters Betty, Marilyn, and Nancy; his nieces and nephews; and for all his dear family and friends. May they all be consoled by the faith they have, the love they share and all the wonderful memories they have of Howie. We pray to the Lord...*

**PLEASE RESPOND: LORD, HEAR OUR PRAYER**

*We pray for all the sick, for those suffering in any way, and for all who give their lives in the service of our country. May God grant them all strong faith and deep peace. We pray to the Lord...*

**PLEASE RESPOND: LORD, HEAR OUR PRAYER**

*We pray for all those who have gone before Howie, his parents Loretta and Earl; his grandparents; and all his dear deceased family and friends. May they all now welcome Howie into the joys of eternal life and rejoice with him forever. We pray to the Lord...*

**PLEASE RESPOND: LORD, HEAR OUR PRAYER**



**OFFERTORY HYMN: LORD, YOU HAVE COME**

Lord, you have come to the seashore,  
neither searching for the rich nor the wise, desiring only that I should follow.

*O, Lord, with your eyes set upon me, gently smiling, you have spoken my name;  
all I longed for I have found by the water, at your side, I will seek other shores.*

Lord, see my goods, my possessions;  
in my boat you will find no power, no wealth. Will you accept, then, my nets and labor?

Lord, take my hands and direct them.  
Help me spend myself in seeking the lost, returning love for the love you gave me.

Lord, as I drift on the waters,  
Be the resting place of my restless heart, my life's companion, my friend and refuge.

Spanish text and music 1979, Cesdreo Gabarain. Published by OCP Pub. All rights reserved.

English translation: Robert C. Trupia, 1987. OCP Pub. All rights reserved

## COMMUNION HYMN:

### ON EAGLE'S WINGS

You who dwell in the shelter of the Lord,  
who abide in His shadow for life,  
Say to the Lord, "My refuge, My rock in Whom I trust."

*And He will raise you up on eagle's wings,  
bear you on the breath of dawn,  
Make you shine like the sun,  
and hold you in the palm of His hand.*

The snare of the fowler will never capture you.  
And famine will bring you no fear.  
Under His wings your refuge, His faithfulness, your shield.

You need not fear the terror of the night,  
Nor the arrow that flies by day.  
Though thousands fall about you, Near you it shall not come.

For to His angels He's given a command,  
To guard you in all of your ways.  
Upon their hands they will bear you up,  
Lest you dash your foot against a stone.

Text: Psalm 91; Michael Joncas, b.1951

Tune: Michael Joncas, b.1951

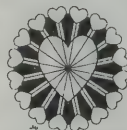
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## COMMUNION MEDITATION: WHAT WONDROUS LOVE

### IRISH BLESSING

May the road rise up to meet you.  
May the wind always be at your back.  
May the sun shine warm upon your face,  
The rain fall soft upon your fields,  
And until we meet again  
May God hold you in the palm of His hand.

Text Unknown. Music by Linda McKeague







## ***CITY OF GOD***

Awake from your slumber! Arise from your sleep!  
A new day is dawning for all those who weep.  
The people in darkness have seen a great light.  
The Lord of our longing has conquered the night.

***Let us build the city of God.  
May our tears be turned into dancing!  
For the Lord, our light and our love  
Has turned the night into day!***

We are the sons of the morning; we are daughters of day.  
The One who has loved us has brightened our way.  
The Lord of all kindness has called us to be  
a light for his people to set their hearts free.

Text: Dan Schutte

Tune: Dan Schutte; Acc. By John Weissrock

Copyright 1981, D. Schutte and North American Liturgy Resources

*ST. ELIZABETH SETON CHURCH  
ORLAND HILLS, ILLINOIS*

## MFJ-557 INSTRUCTIONS

Thank you for your purchase of the MFJ-557 Deluxe Code Practice Oscillator. With its straight Morse key and heavy non-skid metal base, learning code is easy using the MFJ-557. The MFJ-557 has adjustable volume and tone controls. It also has an earphone jack for private listening. The MFJ-557 use a 9V battery or an optional 5V DC power supply can be connected to the power jack on the side.

Here a few notes about the MFJ-557:

1. Remove the top of the MFJ-557 to install the 9V battery. Replace the top for operation.
2. An optional 5-9V DC power supply (MFJ-1305) can be connected to the MFJ-557. If you use your own 5V DC power supply make sure the tip is positive.
3. Use the adjustment knobs of the top of the MFJ-557 to change the volume and tone to your preference. If private listening is desired, connect a mono or stereo earphone or headphones to the subminiature jack on the side of the MFJ-557 labeled "EARPHONE".
4. The straight key of the MFJ-557 can be use to key a transmitter but you may not use the MFJ-557 as a tone monitor for this purpose. The MFJ-557 must be disconnected from the straight key. Disconnect the two wires from the straight key and put them to the side. Connect the transmitter to the two lugs on the straight key. REMEMBER you will destroy the MFJ-557 if you attempt to key a transmitter while the MFJ-557 is still connected to the straight key.

## ONE YEAR LIMITED WARRANTY

MFJ Enterprises, Inc. warrants to the original owner of this product, if purchased from an authorized dealer or directly from MFJ Enterprises, Inc. to be free from defects in materials and workmanship for a period of one (1) year from the date of purchase, provided that the following terms of this warranty are satisfied.

1. The purchaser must retain his proof-of-purchase (bill-of-sale, cancelled check, credit card or money order receipt, etc.) describing the product to establish the validity of any warranty claim and must submit the original or a machine reproduction of such proof-of-purchase to MFJ Enterprises, Inc. at the time warranty service is requested. MFJ Enterprises, Inc. shall have the discretion to deny warranty service without a dated proof-of-purchase. Any evidence of alteration, erasure, or forgery of proof-of-purchase shall be cause to void any and all warranty terms immediately.
2. MFJ Enterprises, Inc. agrees to repair or replace, at the option of MFJ Enterprises, Inc. without charge to the original owner of this product provided that it is returned postage prepaid to MFJ Enterprises, Inc. with a personal check, cashier's check, or money order for \$4.00 to cover return postage and handling.
3. This warranty is VOID if this product is tampered with, improperly serviced, or subject to misuse, negligence, or accidental damage.
4. The obligation of MFJ Enterprises, Inc. under this warranty is limited to the repair or replacement of the defective unit or any part thereof. Under no circumstances is MFJ Enterprises, Inc. liable for consequential damages to persons or property incurred by the use of this product.
5. This warranty is given in lieu of any other other warranties, expressed or implied.
6. MFJ Enterprises, Inc. reserves the right to make changes or improvements in design or manufacture without incurring any obligation to install such changes within any of the products previously manufactured.
7. Warranty service should be addressed to MFJ Enterprises, Inc., 921-A Louisville Road, Starkville, MS 39759, USA and should be accompanied by a letter describing the problem in detail, along with a copy of the dated proof-of-purchase and a check or money order for \$4.00 to cover return postage and handling.
8. This warranty gives you specific rights, and you may also have other rights which vary from state to state.



# Allied knight®-kit VTVM

83 Y 125



**ALLIED RADIO**

CORPORATION



100 N. WESTERN AVE. • CHICAGO 80, ILL. HAYMARKET 1-6800

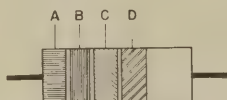
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# CAPACITOR AND RESISTOR COLOR CODE

RESISTOR-MICA CAPACITOR COLOR CODE

Color	Significant Figures	Multiplier	Tolerance %	Voltage Rating*
Black	0	1	$\pm 20^*$	—
Brown	1	10	$\pm 1^*$	100
Red	2	100	$\pm 2^*$	200
Orange	3	1,000	$\pm 3^*$	300
Yellow	4	10,000	$\pm 4^*$	400
Green	5	100,000	$\pm 5^*$	500
Blue	6	1,000,000	$\pm 6^*$	600
Violet	7	10,000,000	$\pm 7^*$	700
Gray	8	100,000,000	$\pm 8^*$	800
White	9	—	$\pm 9^*$	900
Gold	—	.1	$\pm 5$	1,000
Silver	—	.01	$\pm 10$	2,000
None	—	—	$\pm 20$	500

\*Applies to capacitors only



## HOW TO DETERMINE THE VALUE OF A RESISTOR

- A — First significant figure (digit) of resistance in ohms.  
 B — Second significant figure.  
 C — Decimal multiplier (number of zeros to be added).  
 D — Tolerance of resistor in percent. No color is 20%.

### EXAMPLE:

A resistor has the following color bands: A, yellow; B, violet; C, yellow; and D, silver. The significant figures are 4 and 7 (47) and the multiplier is 10,000. The value of resistance is 470,000 ohms and the tolerance is  $\pm 10\%$ .

TUBULAR PAPER CAPACITOR COLOR CODE

Color	Significant Figures	Decimal Multiplier	Tolerance %	Voltage Rating (v d-c)
Black	0	1	$\pm 20$	—
Brown	1	10	—	100
Red	2	100	—	200
Orange	3	1,000	$\pm 30$	300
Yellow	4	10,000	—	400
Green	5	—	—	500
Blue	6	—	—	600
Violet	7	—	—	700
Gray	8	—	—	800
White	9	—	—	900
Gold	—	—	—	1,000
Silver	—	—	$\pm 10$	—

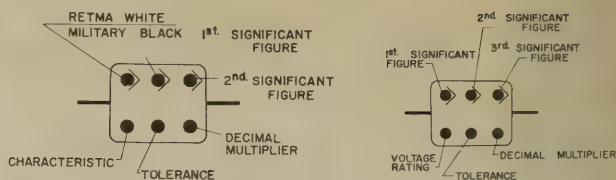


## HOW TO DETERMINE THE VALUE OF A PAPER TUBULAR CAPACITOR

- A — First significant figure (digit) of capacitance in  $\mu\text{f}$ .  
 B — Second significant figure.  
 C — Decimal multiplier (number of zeros to be added).  
 D — Tolerance of capacitor in percent.  
 E — Voltage rating.

### EXAMPLE:

A paper tubular capacitor has the following color bands: A, brown; B, green; C, orange; D, black; and E, yellow. The significant figures are 1 and 5 (15) and the decimal multiplier is 1,000. The value of capacitance is 15,000  $\mu\text{f}$ . The tolerance is  $\pm 20\%$ . The voltage rating is 400 V DC.



## HOW TO DETERMINE THE VALUE OF A MICA CAPACITOR

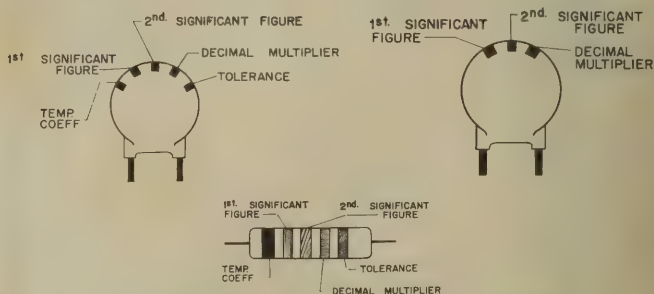
### EXAMPLES:

A capacitor with a 6 dot code (new RETMA standard REC-115A and military MIL-C-5A) has the following markings. Top row, left to right, white, green, brown; bottom row, right to left, brown, red, red. The first color white indicates mica. The significant figures are 5 and 1 (51), and the decimal multiplier is 10. So the capacitance is 510  $\mu\text{f}$ . Tolerance is  $\pm 2\%$ . For most general applications the characteristic can be ignored.

A capacitor with a 6 dot code has the following markings: Top row, left to right, brown, orange, red; bottom row, right to left, brown, red, green. Since the first dot is neither black or white, this is the obsolete RETMA code. The significant figures are 1, 3, and 2 (132), and the decimal multiplier is 10. So the capacitance is 1320  $\mu\text{f}$ . Tolerance is  $\pm 2\%$ . Voltage rating is 500 V DC.

CERAMIC CAPACITOR COLOR CODE

Color	Significant Figures	Decimal Figures	Tolerance		Temp. Coef. (Parts per million per $^{\circ}\text{C}$ .)
			10 $\mu\text{f}$ or less ( $\mu\text{f}$ )	Over 10 $\mu\text{f}$ (%)	
Black	0	1	$\pm 2.0$	$\pm 20$	0
Brown	1	10	$\pm 0.1$	$\pm 1$	-33
Red	2	100	—	$\pm 2$	-75
Orange	3	1,000	—	$\pm 2.5$	-150
Yellow	4	10,000	—	—	-220
Green	5	—	$\pm 0.5$	$\pm 5$	-330
Blue	6	—	—	—	-470
Violet	7	—	—	—	-750
Gray	8	0.01	$\pm 0.25$	—	+150 to -1500
White	9	0.1	$\pm 1.0$	$\pm 10$	+100 to -750
Gold	—	—	—	—	—



## HOW TO DETERMINE THE VALUE OF A CERAMIC CAPACITOR

### EXAMPLES:

A ceramic tubular capacitor has the following color bands: Black, red, red, red, green. The significant figures are 2 and 2 (22), and the decimal multiplier is 100. The capacitance is, therefore, 2200  $\mu\text{f}$ . Tolerance is  $\pm 5\%$ . Temperature coefficient is 0. Voltage rating is always 500 V.

A ceramic disc capacitor has the following 5-dot code: Red, brown, green, red, green. The significant figures are 1 and 5 (15), and the decimal multiplier is 100. The capacitance is, therefore, 1500  $\mu\text{f}$ . The tolerance is  $\pm 5\%$ . The temperature coefficients — 75. Voltage rating is always 500 V.

A ceramic disc capacitor has the following 3-dot code: Green, brown, brown. The significant figures are 5 and 1 (51), and the decimal multiplier is 10. Therefore, the capacity is 510  $\mu\text{f}$ . Voltage rating is always 500 V and the tolerance is always — 0.



## SPECIFICATIONS

### DC Voltmeter:

Ranges.....	1.5, 5, 15, 50, 150, 500, and 1500 volts full scale.
Input Resistance.....	11 Megohms (1 Megohm in probe) on all ranges.
Circuit.....	Push - Pull balanced bridge with 12AU7 twin triode.
Accuracy.....	$\pm 3\%$ full scale.

### AC Voltmeter:

RMS Ranges.....	1.5, 5, 15, 50, 150, 500, 1500 volts full scale.
Accuracy.....	$\pm 5\%$ full scale.
Peak-to-Peak Ranges.....	4, 14, 40, 140, 400, 1400, 4000 volts.

### Ohmmeter:

Ranges.....	Center scale at 10 with multipliers $\times 1$ , $\times 10$ , $\times 100$ , $\times 1000$ , $\times 10K$ , $\times 100K$ , $\times 1Meg$ .
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**Meter:**  $4\frac{1}{2}''$  200  $\mu A$  movement.

**Multipliers:** 1% precision type.

**Printed Circuit:** Copper etched on lami-  
nated phenolic.

**Tube Complement:** 12AU7, twin triode me-  
ter bridge.  
6AL5, twin diode full  
wave rectifier.

**Power Supply:** 105-125 volts, 50-60 cy-  
cles AC.

**Battery:** 1.5 volt "C" battery.

## HOW TO BUILD THE KNIGHT VTVM

Your KNIGHT VTVM uses a printed circuit which assures you that the VTVM will be an accurate, reliable test instrument regardless of age. A sheet of copper is bonded to a sheet of phenolic. When the wiring pattern has been determined, the unused portion of the copper sheet is etched off leaving an exact duplication of the engineering prototype. Exact duplication is one of the greatest advantages of printed circuits, and prevents variation in wiring and performance from instrument to instrument.

Your KNIGHT VTVM is all electronic. That is, the bridge circuit is used for every measurement of DC

voltage, resistance, and AC voltage after rectification by the full-wave rectifier.

The meter employed is an extremely stable, sensitive 200 microampere movement. The multipliers are 1% precision type. Overall accuracy of the DC functions is  $\pm 3\%$  of full scale reading, and  $\pm 5\%$  on AC functions. A wide choice of measurements is provided giving you seven ranges on DC, AC, and resistance. Both RMS and peak-to-peak AC voltages may be measured.

Your KNIGHT VTVM, through the use of the printed circuit, saves a great deal of tedious wiring, assures you of a finished instrument which compares closely to the original engineering model, and provides you with an instrument worth many times its low cost.

Before starting to build your KNIGHT VTVM, check each part against the Parts List on page 23. If you are unable to identify some of the parts by sight, locate them on the pictorial diagrams. Capacitor and resistor values, if not printed on the part, can be found with the aid of the color code chart.

Hardware is listed in the last part of the Parts List. To keep our kits at the lowest possible price, we frequently weigh hardware rather than to count it. Therefore, do not be concerned if more nuts and machine screws, for example, are supplied than are specified in the Parts List.

The only tools required for building your KNIGHT VTVM are: Long-nose pliers, diagonal cutters, screwdriver, set-screw driver, and a soldering iron. A good set of tools is listed at the end of the Parts List.

Study the pictorial diagrams and note how the parts are mounted. These pictorial diagrams show the actual location of all parts and wiring. The schematic diagram shows how the parts are connected electrically and is helpful in understanding how the circuits work.

The step-by-step instructions were prepared by a skilled technician while he was actually building the KNIGHT VTVM. Therefore, they are the best and fastest way of assembling this instrument. We suggest that you read through the instructions before building the VTVM. This will enable you to familiarize yourself with the procedure and avoid possible errors. We invite you to use the blank parentheses, ( ), before each step to check it off after you have completed it.

Each step is clearly illustrated on an accompanying line drawing. Some builders prefer to "cross out" each wire and component on the drawings with a colored pencil after it is installed. While an excellent way to avoid mistakes, and highly recommended by us, this procedure results in drawings that are difficult to re-use. For this reason each wiring view is reproduced on a separate, folded sheet of paper.

You are now ready to build your KNIGHT VTVM.



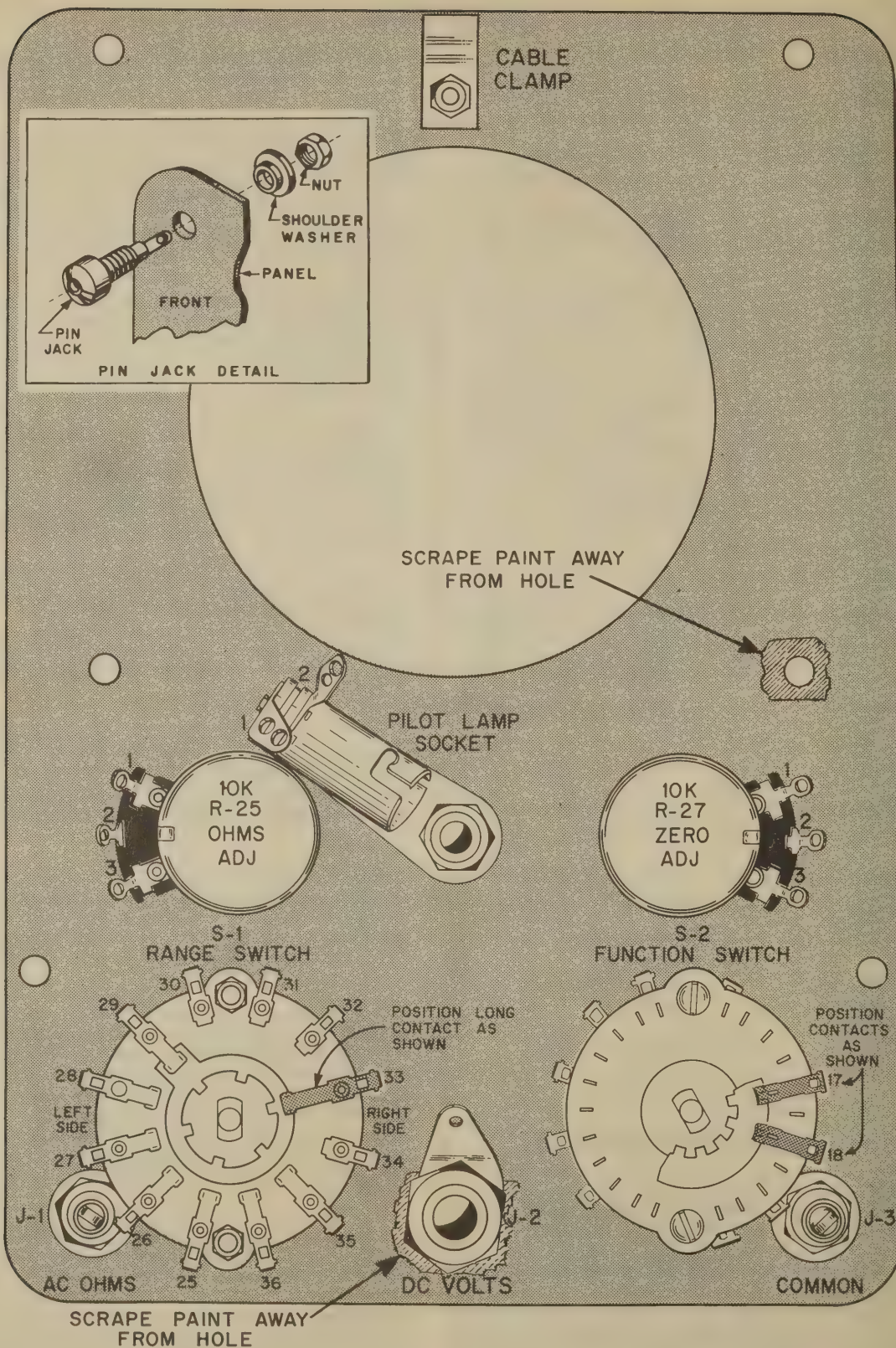


FIGURE 1. MOUNTING THE PARTS ON THE PANEL



## MOUNTING THE PARTS ON THE PANEL

Before you begin mounting the parts, place a pad or a soft cloth on your work table to protect the finish on the front panel.

### SEE FIGURES 1 AND 2

- (✓) Insert the short flat head screw through the hole in the top center of the panel. Place an external lockwasher over the screw. Next put one of the cable clamps over the screw. Now, put on an internal lockwasher and tighten a nut over it very securely. See Figure 2.

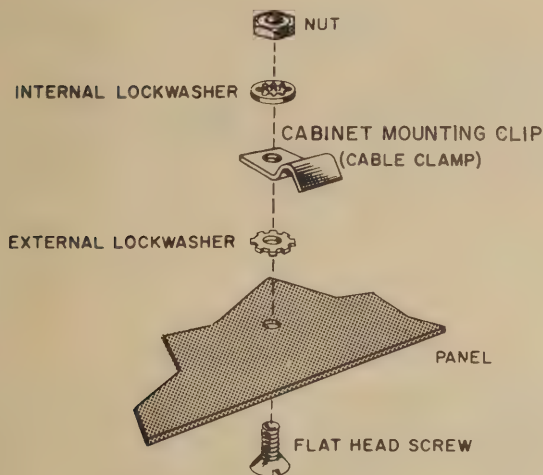


FIGURE 2. HOW TO ASSEMBLE THE CABINET CLAMP

- (✓) Mount R-25, 10K ohms OHMS ADJUST potentiometer, in the large hole in the left center of the panel. Use two nuts to mount this control as shown in Figure 3.

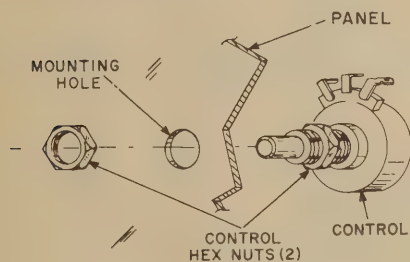


FIGURE 3. HOW TO MOUNT A CONTROL

- (✓) Mount R-27, 10K ohm ZERO ADJUST potentiometer, in the large hole in the right center of the panel, in the same manner.
- (✓) Mount the pilot light socket between R-25 and R-27. The bracket must be positioned as shown in Figure 1.
- (✓) Mount J-1, the red pin jack, in the lower left corner of the panel. Use a **shouldered fiber washer** on the **inside of the panel** to insulate the jack from the panel. Now, tighten a nut against the washer. Refer to the pin jack detail in the upper left corner of Figure 1.

- (✓) Mount J-3, the black pin jack, in the lower right corner of the panel in the same manner.
- (✓) Scrape the paint from the two holes as shown.
- (✓) Mount J-2, the chassis connector in the large hole in the lower center of the panel. This connector is supplied with a shouldered fiber washer. Take this washer off and throw it away. Place the flat fiber washer over the small threaded end of the connector. Scrape the paint from around this hole on the rear of the panel. Insert the small threaded end through the hole in the panel. Place the solder lug and the flat metal washer on the connector and tighten the nut securely. See Figure 4.

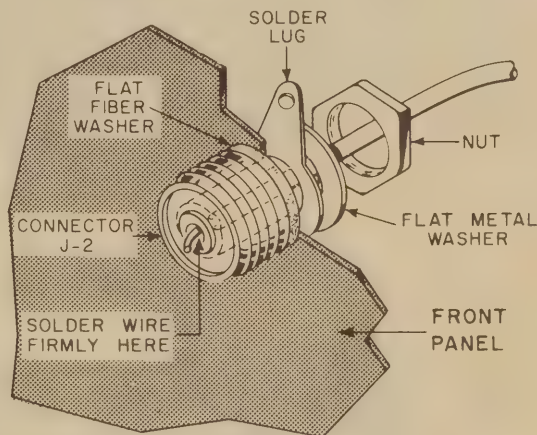


FIGURE 4. HOW TO MOUNT THE CHASSIS CONNECTOR

- (✓) Mount S-1, the long triple wafer RANGE switch in the hole in the lower left corner of the panel. The long contact on the end wafer must be positioned as shown in Figure 1. The blank space on the wafer near the shaft end must be toward J-1. Use a large nut and a lockwasher on the inside of the panel. Fasten it securely with another large nut. Place a large knob on the shaft. Be sure the line on the knob lines up exactly with the printed dots on the panel. If not, rotate S-1 so the scale on the panel and the line on the knob correspond.
- (✓) Mount S-2, the other triple wafer FUNCTION switch, in the other hole on the right of the panel. Use another large nut and lockwasher inside the panel. Use a large nut outside the panel. Again place a knob on the shaft and be sure that the line on the knob lines up with the scale on the panel.

You have finished mounting the parts on the panel until after the switches are wired.

## WIRING AND SOLDERING HINTS

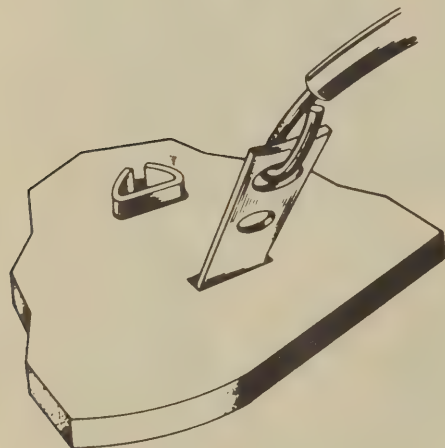
How well a piece of electronic equipment works often depends on the quality of workmanship used in its construction. It is for this reason that the following suggestions are made. These hints are mainly for the beginner, however, even experienced persons may benefit from a brief review.

The insulated wire furnished with this kit is cut to length and the ends are stripped. Each different colored wire is a different length, therefore, be sure to use the color specified in each of the wiring steps.

A long piece of bare wire is included. Whenever it is necessary to use some of it, the exact length of the piece required is given.

The flexible tubing supplied is called "spaghetti". Spaghetti is used to cover the bare end leads of some of the components and portions of some of the bare wires when there is danger they will touch other bare wires or the chassis.

The proper way to connect a wire or lead to a solder terminal is shown in Figure 5. To insure a good mechanical connection, squeeze the wire against the terminal with your long nose pliers after it has been hooked on. Make sure the wires, leads, and terminals are clean before connecting them. If necessary, scrape them with a pocket knife until any foreign substance, such as wax, is removed. Be extremely careful not to nick the wire with the knife, or it may break when it is bent.



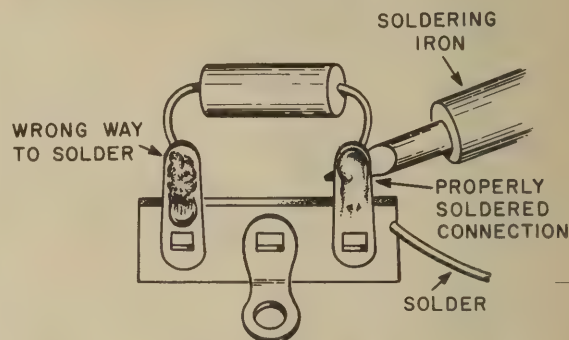
**FIGURE 5. HOW TO CONNECT A WIRE TO A TERMINAL**

Unless otherwise stated, all the leads on the resistors, capacitors, and transformer should be as short as possible. Figure 6 illustrates the best way to connect a component. As shown, the end leads should be pulled through the terminals so that the parts are tightly mounted. After a lead is pulled through a terminal, bend it around the terminal and cut off the excess wire.

### USE ONLY ROSIN CORE SOLDER

KITS WIRED WITH ACID CORE SOLDER OR PASTE FLUX WILL CORRODE AND WILL NOT WORK LONG. SUCH KITS ARE NOT ELIGIBLE FOR REPAIR OR SERVICE. DO NOT USE A SAL AMMONIAC BLOCK TO CLEAN YOUR IRON. IT IS VERY CORROSIVE.

Before soldering, the tip of your soldering iron must be properly tinned. To do this, clean the surfaces of the tip with steel wool, or a fine file, until the bright copper surface is exposed. Plug the iron in and allow it to heat until it melts solder. Apply solder to the tip until it is well covered with a thin coat. Wipe off the excess solder with a rag. The tip should now be "shiny". Re-tin the tip whenever it becomes covered with a layer of scale (flakes of gray matter).



**FIGURE 6. THE BEST WAY TO CONNECT A COMPONENT**

Before soldering a connection be sure the iron is hot enough to melt solder. Preheat the CONNECTION by holding the tip of the iron against the joint to be soldered. After the joint is heated, apply solder between the connection and the iron tip. Use only enough solder to fill the crevices and cover all of the wires and the terminal. Do not solder any connection until all wires have been connected to it.

After you have soldered a connection, push any insulation or spaghetti as close to the connection as possible. This will prevent close connections from touching one another and causing a short.

When wiring the contacts of the switches, be careful not to bend the switch contacts which will reduce the spring pressure of the contacts. If the flux runs out around the contacts, it will cause a leakage path.

The precision resistors furnished with your VTVM are sensitive to heat. When you make a solder connection close to the body of one of these resistors, hold the lead with the long nose pliers between the body and the connection to be soldered. The jaws of the pliers will conduct the heat away from the body of the resistor.

You are now ready to begin wiring your KNIGHT VTVM. As you are wiring, we would like you to keep the following in mind: Do your best to position the parts as shown in the wiring diagrams, and, above all, USE ONLY ROSIN CORE SOLDER.

### WIRING SWITCH S-1

S-1 is the three wafer switch in the lower left corner of the panel. The open space between two of the terminals, on the wafer nearer the shaft end, is used as the reference point for numbering the terminals.



SEE FIGURE 7.

- (✓) Connect, but do not solder, one end of R-2, 320K ohm resistor, to terminal 1 of S-1. Connect, but do not solder, the other end to terminal 4 of S-1. Position R-2 as shown in Figure 7.
- (✓) Connect, but do not solder, one end of R-3, 900K ohm, 1 watt, resistor, to terminal 1. Connect, but do not solder, the other end to terminal 6. Position R-3 as shown in Figure 7.
- (✓) Solder one end of a 2 inch bare wire to terminal 1. Insert the other end through a  $1\frac{1}{4}$  inch length of spaghetti. Solder it to terminal 5.
- (✓) Solder one end of R-1, 150K ohm resistor, to terminal 4. Connect, but do not solder, the other end to terminal 13.
- (✓) Connect, but do not solder, one end of R-16, 10K ohm resistor, to terminal 13. Insert the other end through a  $\frac{1}{2}$  inch length of spaghetti. Connect, but do not solder, it to terminal 17.

- (✓) Connect, but do not solder, one end of R-20, 90K ohm resistor, to terminal 14. Connect, but do not solder, the other end to terminal 25.
- (✓) Connect, but do not solder, one end of a 2 inch bare wire to terminal 14. Solder the other end to terminal 26.
- (✓) Solder one end of R-21, 9K ohm resistor to terminal 14. Connect, but do not solder, the other end to terminal 27.
- (✓) Connect, but do not solder, one end of R-22, 900 ohm resistor, to terminal 16. Solder the other end to terminal 27.
- (✓) Connect, but do not solder, one end of a 2 inch bare wire to terminal 16. Solder the other end to terminal 28.
- (✓) Solder one end of R-23, 90 ohm resistor, to terminal 16. Connect, but do not solder, the other end to terminal 29.

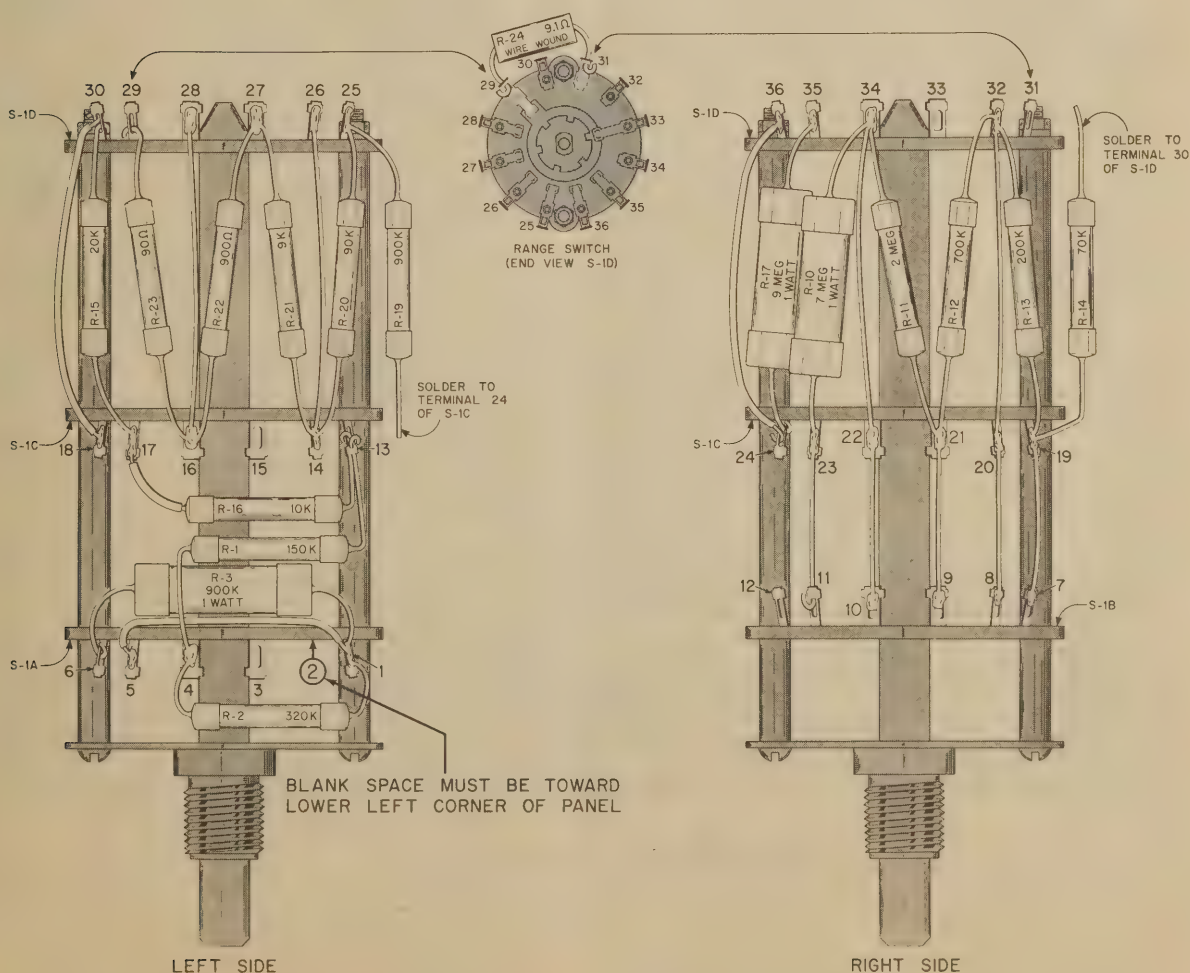


FIGURE 7. HOW TO WIRE THE RANGE SWITCH

- (✓) Solder one end of R-15, 20K ohm resistor, to terminal 17. Connect, but do not solder, the other end to terminal 30.
- (✓) Solder one end of a 2 inch red wire to terminal 18. Connect, but do not solder, the other end to terminal 30.
- (✓) Pass one end of R-14, 70K ohm resistor through terminal 19 and connect it to terminal 7. Solder terminal 7, but do not solder terminal 19. Solder the other end of R-14 to terminal 30.
- (✓) Solder one end of R-13, 200K ohm resistor, to terminal 19. Connect, but do not solder, the other end to terminal 32.
- (✓) Pass one end of a 3 inch bare wire through terminal 20 and connect it to terminal 8. Solder both terminals 8 and 20. Connect, but do not solder, the other end to terminal 32.
- (✓) Connect, but do not solder, one end of R-12, 700K ohm resistor, to terminal 21. Solder the other end to terminal 32.
- (✓) Pass one end of R-11, 2 Megohm resistor, through terminal 21 and connect it to terminal 9. Solder both connections. Connect, but do not solder, the other end to terminal 34.
- (✓) Pass one end of a 3 inch bare wire through terminal 22 and connect it to terminal 10. Solder both connections. Connect, but do not solder, the other end to terminal 34.
- (✓) Pass one end of R-10, 7 Megohm, 1 watt, resistor, through terminal 23, and connect it to terminal 11. Solder terminal 23, but do not solder terminal 11. Solder the other end to terminal 34.
- (✓) Connect, but do not solder, one end of R-17, 9 Megohm, 1 watt resistor, to terminal 24. Solder the other end to terminal 35.
- (✓) Connect, but do not solder, one end of a red wire to terminal 24. Solder the other end to terminal 36.
- (✓) Solder one end of R-19, 900K ohm resistor, to terminal 24. Solder the other end to terminal 25.
- (✓) Solder one end of R-24, the 9.1 ohm wirewound resistor marked with the color bands white, brown, gold, and gold, to terminal 29. Connect, but do not solder, the other end to terminal 31.
- (✓) Solder one end of another orange wire to the terminal on J-3, the common jack. Solder the other end to the solder lug.
- (✓) Pass one end of a red wire through the chassis connector. Solder it to the eyelet in the center of the connector. Insert the other end through a 1½ inch length of the large spaghetti. Force the spaghetti down against the soldered eyelet connection. Solder the other end of the red wire to terminal 1 of S-2.
- (✓) Insert each end lead of C-2, .01 MFD paper capacitor, through a 1½ inch length of small spaghetti. Solder the lead from the banded end to terminal 9 of S-2. Solder the other lead to terminal 6 of S-1. Position C-2 between J-2 and S-2A.
- (✓) Solder one end of a red wire to terminal 11 of S-1. Solder the other end to terminal 2 of S-2.
- (✓) Solder one end of a yellow wire to terminal 12 of S-1. Solder the other end to terminal 6 of S-2.
- (✓) Insert a green wire through a 4½ inch length of the large spaghetti. Solder one end to J-1. Solder the other end to terminal 8 of S-2.
- (✓) Solder one end of a green wire to terminal 3 of S-1. Connect, but do not solder, the other end to terminal 15 of S-2.
- (✓) Solder one end of a yellow wire to terminal 1 of R-25. Solder the other end to terminal 11 of S-2.
- (✓) Solder one end of a blue wire to terminal 2 of R-25. Connect, but do not solder, the other end to terminal 1 of R-27.
- (✓) Solder one end of a green wire to terminal 33 of S-1. Solder the other end to terminal 7 of S-2.
- (✓) Solder one end of a red wire to terminal 12 of S-2. Connect, but do not solder, the other end to terminal 3 of R-27.
- (✓) Solder one end of a green wire to terminal 15 of S-1. Solder the other end to terminal 4 of S-2.

#### SEE FIGURE 9.

- (✓) Be sure the paint is scraped from around the lower right meter mounting hole on the rear of the panel.
- (✓) Mount the meter from the front of the panel. Tighten one of the nuts supplied with the meter over each of the two top screws and the lower left screw. Do not tighten them too securely. Place an internal tooth lockwasher and the other cable clamp over the lower right screw. Now, tighten a nut over the screw. You will use the other four nuts supplied with the meter to mount the printed circuit board.
- (✓) Solder one end of a blue wire to terminal 14 of S-2. Solder the other end to the solder lug on the negative meter post.
- (✓) Solder one end of a violet wire to terminal 10 of S-2. Solder the other end to the solder lug on

You have finished mounting the precision resistors. Recheck all of your work.

### HOW TO WIRE THE PANEL

#### SEE FIGURE 8.

- (✓) Solder one end of a green wire to terminal 1 on the pilot light socket. Connect, but do not solder, the other end to the solder lug under the chassis connector nut.
- (✓) Solder one end of an orange wire to terminal 13 on S-1. Connect, but do not solder, the other end to the solder lug.



the positive meter post.

connected to the printed circuit later.

- (✓) Solder one end of another violet wire to terminal 2 of the pilot light socket. The other end will be

- (✓) Insert the pilot lamp into its socket.

#### NOTE

SWITCHES ARE SHOWN  
EXPANDED AND SIMPLIFIED

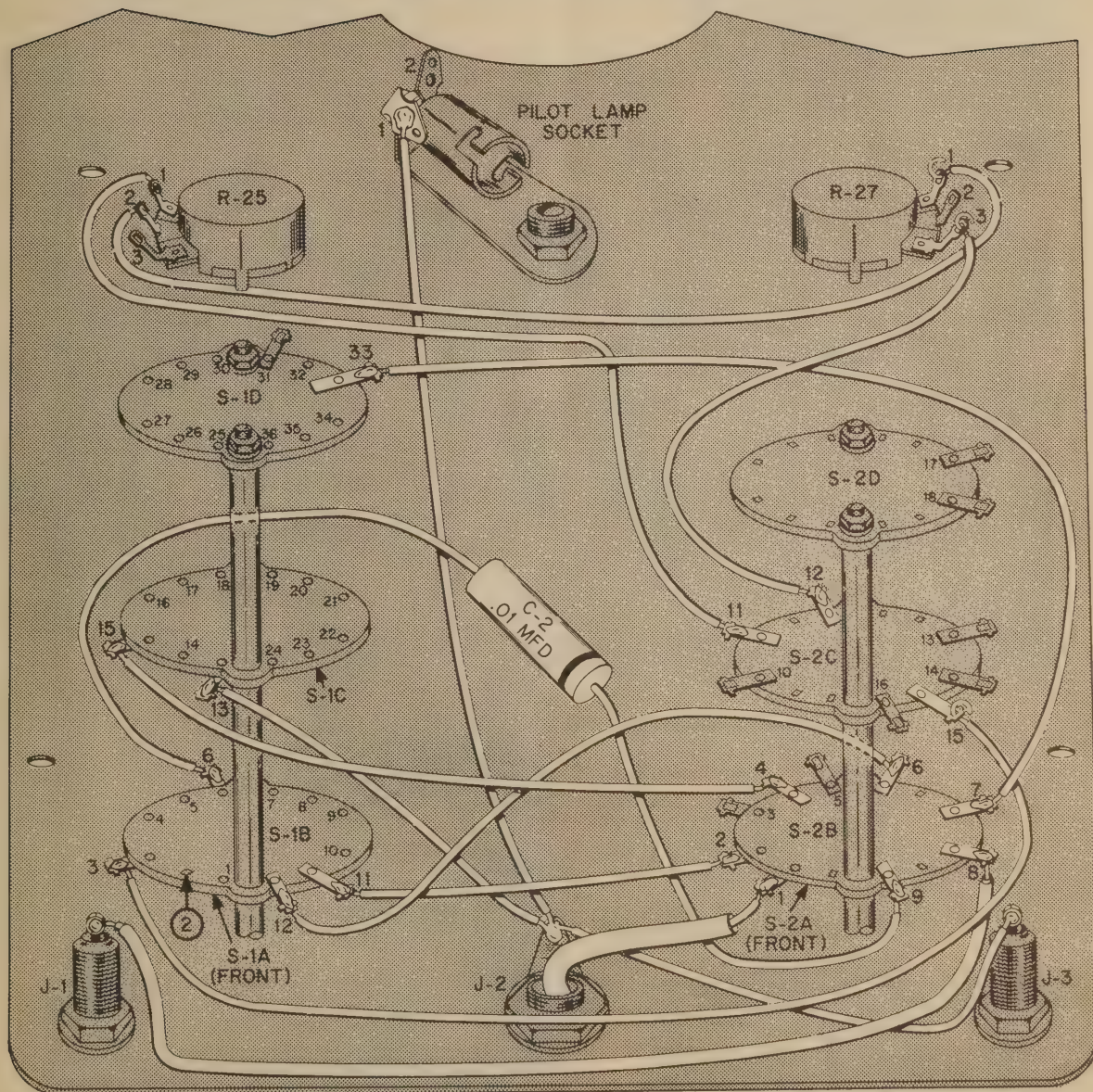


FIGURE 8. HOW TO WIRE THE PANEL



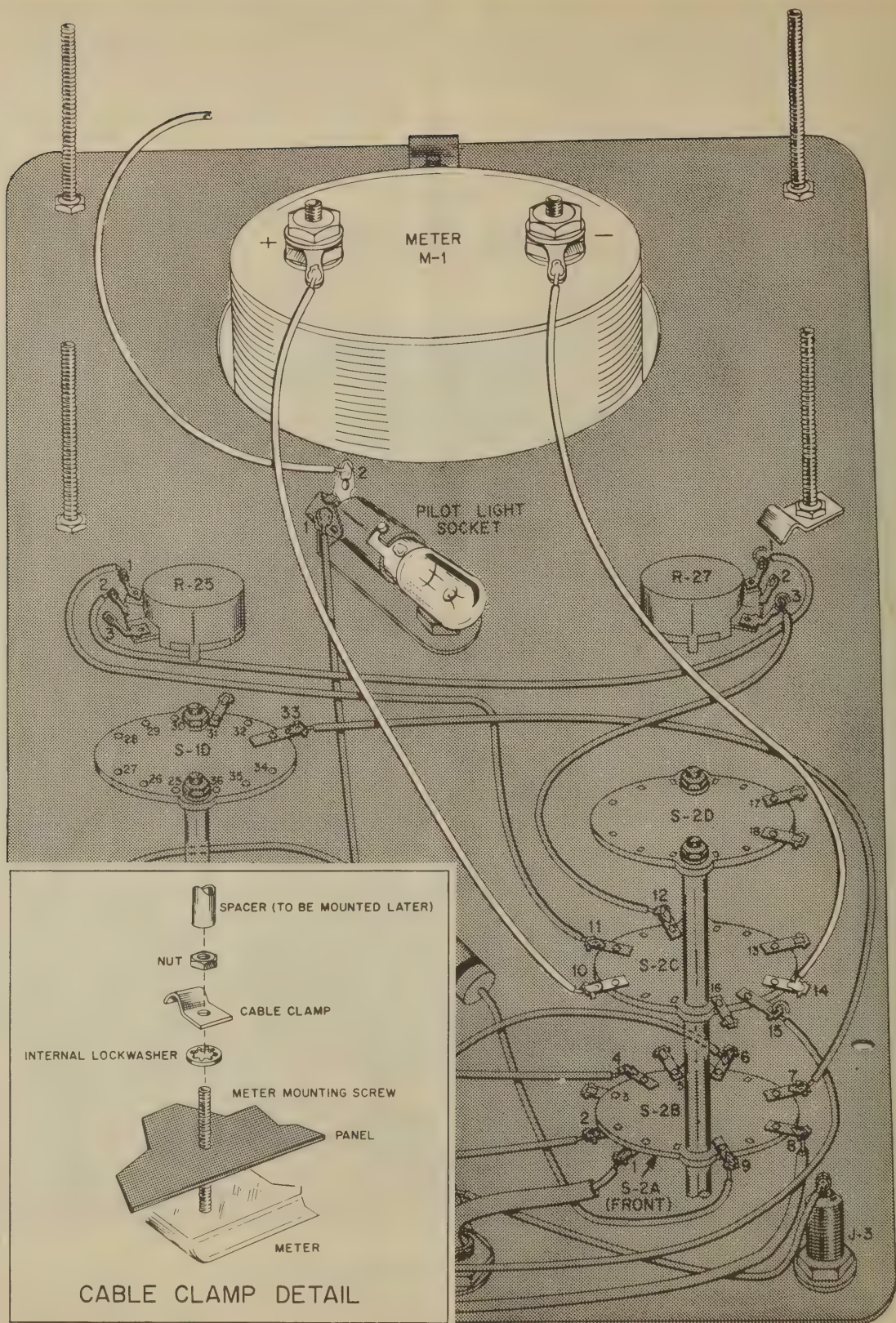


FIGURE 9. HOW TO MOUNT AND WIRE THE METER



## ASSEMBLING THE PRINTED CIRCUIT BOARD

You are ready to mount the parts on the printed circuit board. Examine it. One side shows the outline and value of each part to be mounted. That is, the capacitors, resistors, the transformer, the battery, etc., are pictured in their exact location.

The following procedure assures well soldered connections on the printed circuit board. Study it.

1. INSERT the wire leads of the parts through the holes as shown in Figure 11.
2. BEND LEADS FLAT against the foil side of the board so the part is held securely in place.
3. SOLDER EACH LEAD of each part (after all parts are mounted) right at the hole in the metal foil where the lead comes through. Be sure you heat the connection until the solder runs and spreads.
4. CUT OFF EACH LEAD as close as possible to the board. Inspect each lead after cutting it off to be sure it does not short across the bakelite from one foil conductor to another. This would cause a short and your VTVM won't work.

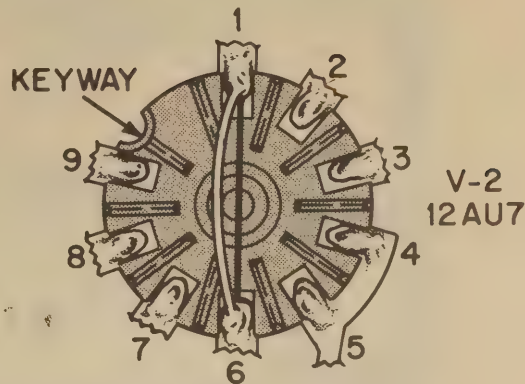
If a soldered connection should have a dull appearance it is not a good solder connection. Using more solder, again solder the connection. Do not use so much solder that it runs off the printed foil wiring onto the board and touches another foil conductor. This may cause an intermittent or a short between connection points.

Before you solder the tabs of the tube sockets to the metal foil, insert the tubes in the sockets. When you solder the tabs of the tube sockets to the metal foil, heat the tube socket tab until the solder runs down onto the metal foil and spreads.

After you have soldered all the connections on the printed circuit board, but before you put in the cable, examine the metal foil side of the board carefully. Again be sure no solder or cut-off lead touches any foil conductor except the one to which it is soldered. Also, be sure the tabs of the controls have not been bent so much that they touch any other conductor. If the flux from the solder has run out around the connections that is all right. The flux is not conductive.

### SEE FIGURE 11.

- (✓) Mount the 9-pin miniature socket for V-2, the 12AU7, from the screened side of the board. This socket can be mounted only one way. Line up the notch in the socket with the half-moon shaped notch in the board. Put the 12AU7 in the socket. Solder one end of a 1 inch bare wire to pin 1. Solder the other end to pin 6. The wire must not touch the bottom of the socket. Solder all pins to the board. See Figure 10.
- (✓) Mount the 7-pin miniature socket for V-1, the 6AL5. Put the 6AL5 in the socket. Solder all pins.
- (✓) Mount R-34, 10,000 ohms AC Balance potentiometer, from the screened side of the board. The three terminals must be toward the left edge of the board. Bend the two large, flat terminals out slightly so the potentiometer is held firmly. Do not bend either flat terminal so much that it touches another foil conductor.



**NOTE:- DO NOT ALLOW JUMPER WIRE TO TOUCH BOTTOM OF SOCKET.**

FIGURE 10. JUMPER WIRING ON V-2.

Solder each terminal and also the two large flat terminals.

- (✓) Mount R-29, 10,000 ohms DC Calibration potentiometer in the same manner. Solder the large flat terminals and the two small terminals.
  - (✓) Mount R-26, 10,000 ohms AC Calibration potentiometer in the same manner with the three terminals toward the terminals of R-29. Solder the three terminals which go into the printed wiring.
  - (✓) Mount CR-1, the rectifier, by inserting the two terminals through the holes in the upper left corner of the board. The positive side must be toward the right. Bend the two terminals slightly to hold CR-1 firmly. Solder both terminals.
  - (✓) Mount C-6, the 20 MFD, 200V electrolytic filter capacitor, with the "+" end next to the rectifier. Solder both leads.
  - (✓) Trim the leads of T-1, the power transformer to the following lengths:
    - The black lead toward the upper right corner to 1½".
    - The other black lead to 6".
    - Both green leads to 1½".
    - Both red leads to 2".
- Remove the insulation from ¼" of the end of each lead. Hold the lead with pliers close to the body of the transformer as you remove the insulation so that you do not tear the lead through the wrapping around the winding of the transformer. Now, coat the stripped end of each lead with solder.
- Mount T-1 with the red and green leads toward the center of the board. Use a 6-32 x ¼" machine screw through each mounting tab of T-1, through a flat fiber washer, and through the board. Tighten a nut over each screw.
- (✓) Insert the short black lead into the hole marked Black Pri. in the upper right corner of the board.



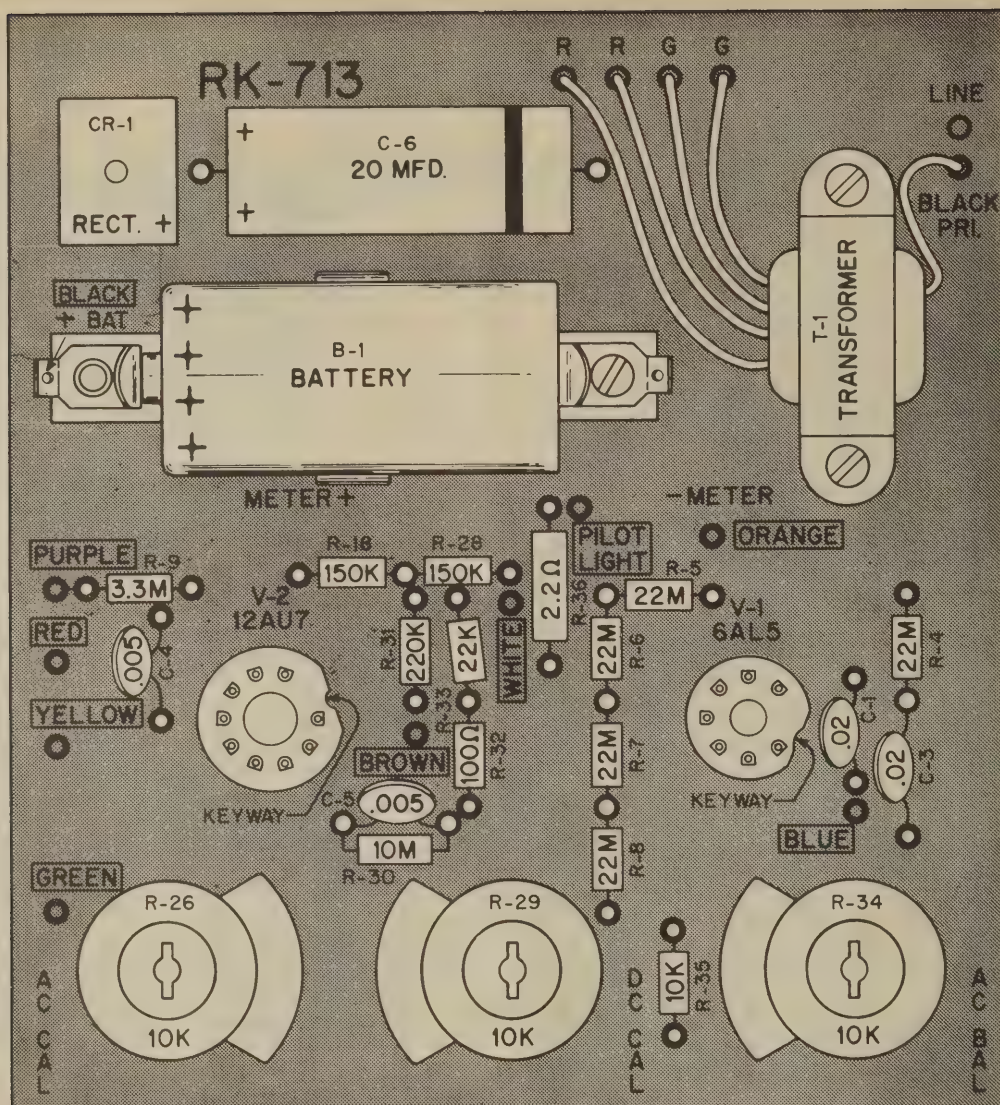


FIGURE 11. MOUNTING THE PARTS ON THE PRINTED CIRCUIT BOARD

Bend it slightly so it will stay in position and solder it. The other black lead will be connected later.

- (✓) Insert the green leads into the holes marked G. Bend them slightly. Solder them.
- (✓) Insert the red leads into the two holes marked R. Bend them slightly. Solder both.

#### SEE FIGURES 11 AND 12.

- ( ) Mount the battery brackets as shown in Figure 12. Insert the 6-32 x 5/16" machine screw through the battery retaining clip through the center hole in the battery bracket, through a flat fiber washer, and through the hole in the printed circuit board. Tighten a nut onto the screw. Use the thin screw through the hole in the end of the bracket near T-1, and through the circuit board. Place a small flat metal washer over the screw on the printed wiring side of the board and tighten a nut over the screw.

You are now ready to mount the resistors and capacitors on the printed circuit board.

- (✓) Mount R-9, 3.3 Megohm resistor (orange, orange, green) as shown in Figure 11.
- (✓) Mount C-4, .005 MFD disc capacitor.
- (✓) Mount R-18, 150K ohm resistor (brown, green, yellow).
- (✓) Mount R-28, 150K ohm resistor (brown, green, yellow).
- (✓) Mount R-33, 22K ohm resistor (red, red, orange).
- (✓) Mount R-31, 220K ohm resistor (red, red, yellow).
- (✓) Mount R-32, 100 ohm resistor (brown, black, brown).
- (✓) Mount C-5, .005 MFD disc capacitor.



- (✓) Mount R-30, 10 Megohm resistor (brown, black, blue).
- (✓) Mount R-36, 2.2 ohm resistor (red, red, gold, gold).
- (✓) Mount R-5, 22 Megohm resistor (red, red, blue).
- (✓) Mount R-6, 22 Megohm resistor (red, red, blue).
- (✓) Mount R-7, 22 Megohm resistor (red, red, blue).
- (✓) Mount R-8, 22 Megohm resistor (red, red, blue).
- (✓) Mount R-35, 10K ohm resistor (brown, black, orange).
- (✓) Mount C-1, .02 MFD disc capacitor.
- (✓) Mount R-4, 22 Megohm resistor (red, red, blue).
- (✓) Mount C-3, .02 MFD disc capacitor. Note that the leads of this capacitor must be positioned so that they clear the hole for mounting the printed circuit to the panel.
- (✓) Turn the circuit board over and solder each connection. Remember to use a small iron and the rosin-core solder supplied. Be sure the connection where R-18, R-28, and R-31 join is well soldered. Cut off each end lead close to the soldered connection.

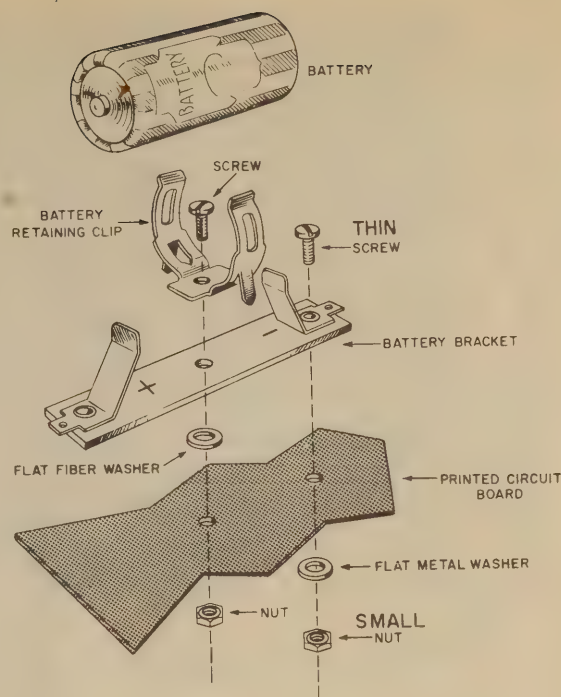


FIGURE 12. MOUNTING THE BATTERY

## FINAL WIRING

You are now ready to prepare the cable and do the final wiring on your VTVM.

### SEE FIGURE 13.

- ( ) Carefully remove  $4\frac{1}{2}$  inches of the outer insulation from one end of the cable. Be very careful not to cut the insulation of any of the wires. Now, trim the wires to the following lengths:

Orange:	Leave it the full $4\frac{1}{2}$ inches.
Green:	1"
Yellow:	1"
Red:	$1\frac{1}{2}$ "
Violet:	$1\frac{3}{4}$ "
Black:	$2\frac{3}{4}$ "
Brown:	$2\frac{1}{4}$ "
White:	$3\frac{1}{2}$ "
Blue:	$4\frac{1}{4}$ "

Remove  $\frac{1}{4}$  inch of insulation from the end of each wire. Coat each end with solder.

- (✓) Solder the black wire to the terminal on the battery bracket marked + Bat. This wire does not go through the printed circuit board.
- (✓) Insert each of the other wires into the hole in the board marked with the corresponding color. Solder each on the printed wiring side of the board.
- (✓) Remove  $3\frac{3}{4}$ " of the outer insulation from the other end of the cable. Trim each wire as follows:

Red:	Leave it the full $3\frac{3}{4}$ "
White:	$2\frac{3}{4}$ "

Brown:	$2\frac{1}{2}$ "
Violet:	$1\frac{1}{2}$ "
Yellow:	$2\frac{3}{4}$ "
Blue:	3"
Green:	$3\frac{3}{4}$ "
Orange:	2"
Black:	3"

Remove  $\frac{1}{4}$ " of insulation from the end of each wire. Coat each end with solder.

- (✓) Solder the violet wire to terminal 5 of S-2.
- (✓) Solder the brown wire to terminal 3 of R-27.
- (✓) Solder the white wire to terminal 2 of R-27.
- (✓) Solder the red wire to terminal 1 of R-27.
- (✓) Solder the yellow wire to terminal 13 of S-2.
- (✓) Solder the blue wire to terminal 15 of S-2.
- (✓) Solder the green wire to terminal 16 of S-2.
- (✓) Solder the orange wire to terminal 3 of S-2.
- (✓) Solder the black wire to terminal 31 of S-1.
- (✓) Solder the violet wire from terminal 2 of the pilot light socket to PILOT LIGHT on the printed circuit board. Bring this wire over the screened side of the board.





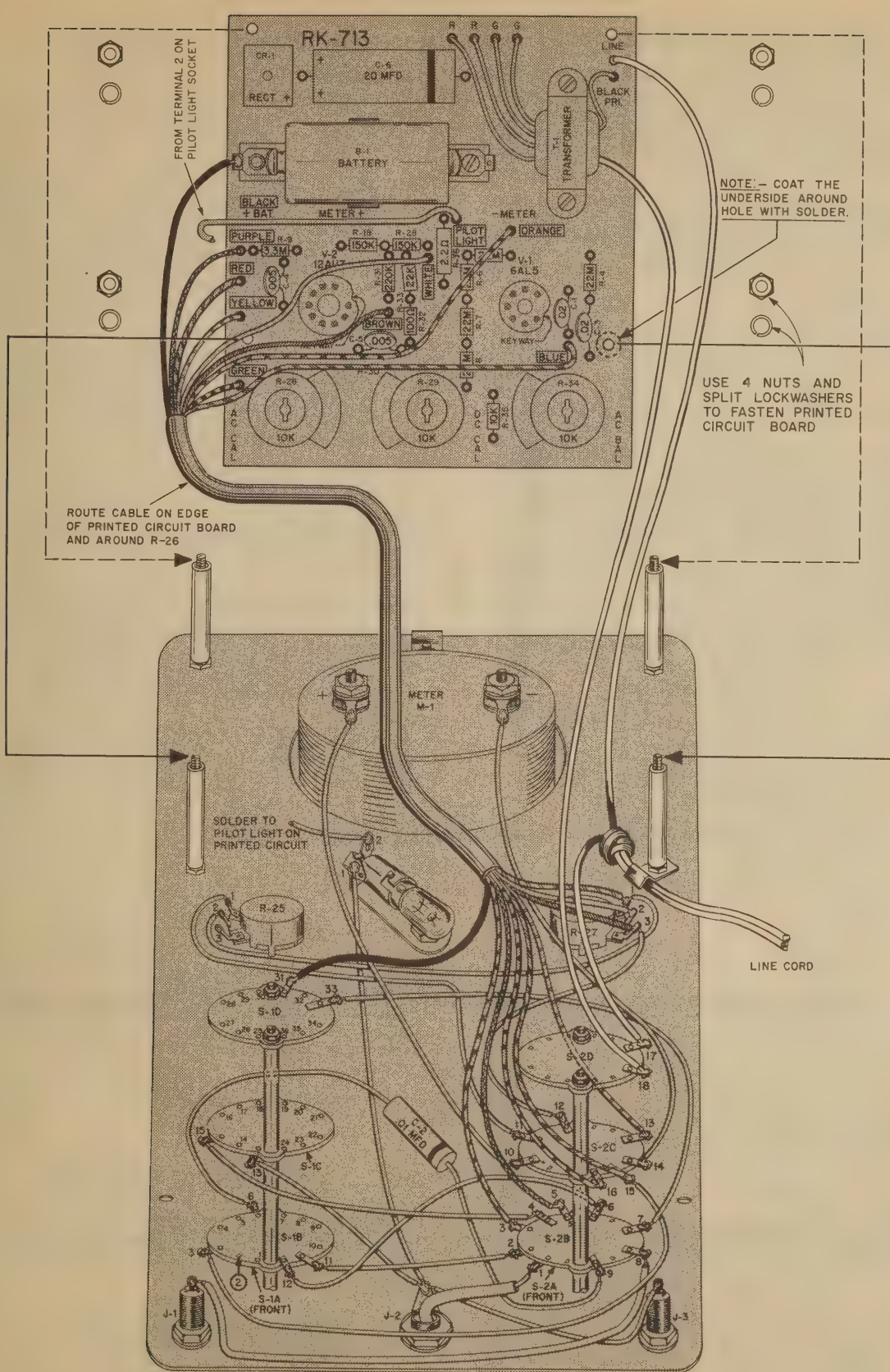


FIGURE 14. HOW TO MOUNT THE PRINTED CIRCUIT BOARD

## PRELIMINARY ADJUSTMENTS

**CAUTION: NEVER TOUCH ANY PART OF THE WIRING WHILE THIS INSTRUMENT IS PLUGGED INTO A POWER OUTLET. NEVER USE OR TEST THE VTVM ON OR NEAR A GROUNDED METAL BENCH, RADIATOR, SINK, OR OTHER GROUNDED METAL OBJECT.**

- ( ) Again check to see that the white line on the knob of S-1 lines up with the scale on the front panel. If not, loosen the nut and move S-1 so that it does. Retighten the nut.
- ( ) Also check S-2.
- ( ) Rotate the shafts of the OHMS ADJUST control, R-25, and the ZERO ADJUST control, R-27, fully counterclockwise. Place a small knob on each shaft so that the white line points to the lower left. Tighten each set screw.
- ( ) Plug the line cord into a 117 volt, 60 cycle, AC outlet. NEVER connect the VTVM to direct current or you will damage the instrument. If you are not certain as to the power available, check with your local power company.
- ( ) Turn the VTVM on. Set the FUNCTION switch to either + DC or —DC volts. Set the RANGE switch to 1.5 volts. The pilot lamp and tubes should light. Turn the knob of the ZERO ADJUST control. The meter needle will deflect over at least part of the scale.
- ( ) Leave the VTVM on while you prepare the test leads. This will give the tubes ample time for warmup before calibration.

## TEST LEAD ASSEMBLY

SEE FIGURE 15.

There are three test leads to be prepared for your VTVM.

- ( ) Remove the small setscrew from the cable plug and remove the spring from the plug. Slide the spring (large hole first) over one end of the shielded cable. Remove  $\frac{1}{2}$  inch of the outer insulation from one end of the cable. Unravel the braid and bend it back over the spring. Remove  $\frac{1}{8}$  inch of the insulation from the inner conductor. Insert the cable and spring into the open end of the plug.

The inner conductor must fit into the small hole of the plug. The braid and spring should fit into the plug so that the setscrew will tighten on the spring. Tighten the setscrew. Solder the inner conductor to the eyelet.

- ( ) Remove  $\frac{1}{2}$  inch of the outer insulation from the other end of the shielded cable. Trim the braided shielding back even with the cut off insulation. Remove  $\frac{1}{4}$  inch of the insulation from the inner conductor. Form a small hook in it.
- ( ) Cut one lead of R-37, 1 megohm 5% resistor, to  $\frac{1}{4}$ ". Form a small hook in it. Hook R-37 to the inner conductor of the shielded cable. Crimp the two together. Solder the connection. Do not overheat or the insulation around the inner conductor may soften.
- ( ) Trim the other lead of R-37 to  $\frac{5}{8}$  inch from the body.

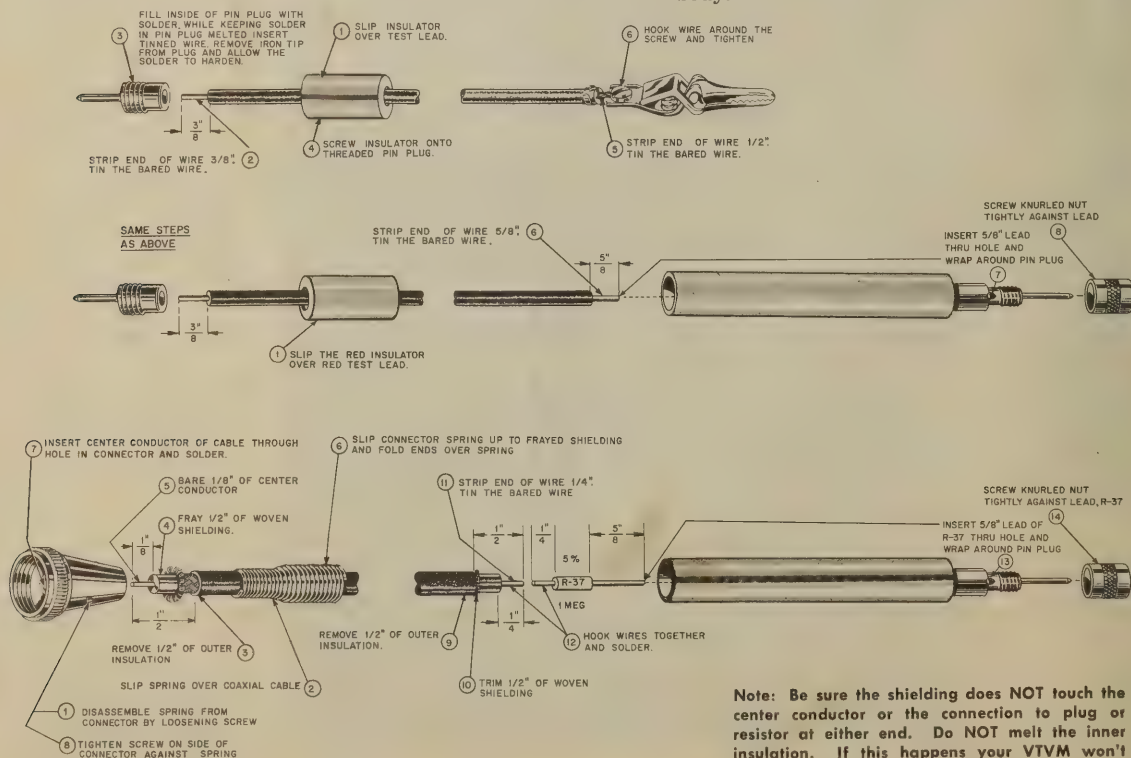


FIGURE 15. HOW TO ASSEMBLE THE TEST LEADS



- ( ) Insert the  $\frac{5}{8}$  inch lead into the prod handle and out the small hole near the threads on the prod tip. Pull R-37 through the prod handle and into the prod tip. Wrap the lead around the base of the prod tip. Screw the nut back onto the prod tip. Tighten it securely so that the lead of R-37 is held very firmly.
- ( ) Remove  $\frac{5}{8}$ " of the insulation from one end of the red test lead wire. Coat the fine wires with solder. Insert the end through the prod handle and into the prod tip so the bared end comes through the small hole. Wrap it around the base of the prod tip. Screw the nut on very tightly.
- ( ) Unscrew the short red insulator from the tip plug. Slide it over the other end of the red wire. Remove  $\frac{3}{8}$ " of the insulation. Twist the wires and coat them with solder. Fill the tip plug with solder. Insert the bare end into the tip and let the solder cool.
- ( ) Prepare one end of the black test lead in the same way.
- ( ) Remove  $\frac{1}{2}$ " of the insulation from the other end of the black test lead. Twist the wires and coat them with solder.
- ( ) Loosen the screw at the back of the clip. Form a hook in the solder coated wires. Hook the wire around the screw in a clockwise direction. Tighten the screw. Now, bend the two small prongs at the back of the clip down around the insulation of the lead.

You have finished wiring your KNIGHT VTVM. Check all of your work very carefully. A few extra minutes spent checking your instrument may save hours of trouble-shooting. Be especially sure all the printed circuit connections are shiny.

## MOUNTING THE HANDLE

- ( ) Push the handle mounting studs through the hole in each end of the handle. Insert the stud through the hole in the meter case on one side. Use a large flat metal washer, a shakeproof washer and one of the larger hex nuts to fasten it.
- ( ) Mount the other stud in the other side of the case.

## USE OF THE CONTROLS

The **FUNCTION SWITCH**, S-2, serves two purposes. One, turns the power off when the switch is in the off position. Two, selects the operating function desired.

The **RANGE SWITCH**, S-1, provides wide choice of ranges for voltage and resistance measurements.

The **ZERO ADJUST**, R-27, controls meter needle position at the left zero position or sets the needle at the zero-center, "0", when the function switch is in **VOLTS** position.

The **OHMS ADJUST** potentiometer, R-25, positions the meter needle at the extreme right of the scale when the function switch is in the **OHMS** position.

The **DC VOLTS** chassis connector is used for all DC voltage measurements with the DC test prod. The black test lead must be plugged in the **COMMON** jack for all of these measurements.

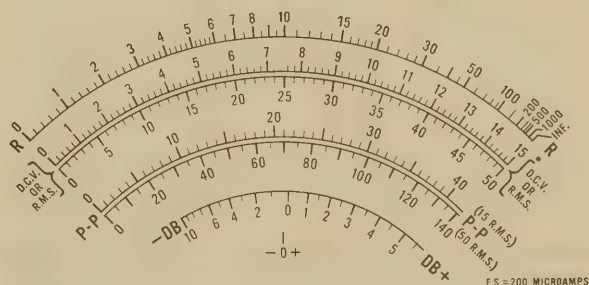
The **AC-OHMS** jack is used for all AC voltage and resistance measurements. The red test lead must be plugged into this jack. The black test lead must also be plugged into the **COMMON** jack.

The **COMMON** jack is connected directly to the panel of the VTVM and is the return point for all measurements.

## READING THE SCALES OF THE METER

Study the face of the meter on your VTVM. A reproduction of the meter scales is shown below. You will notice the scale for resistance is the top red scale. Read this scale from left to right. Each of the 7 positions of the **RANGE** switch is marked with a resistance multiplier. In the **Rx1** position any value between 0 and 1000 ohms may be read directly. Ten is the multiplier for the next position, 100 for the next, 1000 the next, 10K (where K indicates 1000), 100K and 1 meg or 1,000,000. Therefore, the largest resistance which can be measured is 1000 megohms.

# Knight



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You will notice that the next two scales (black) are bracketed and marked **D.C.V.** or **R.M.S.** All DC and AC rms voltages are read on these two scales. The value of the voltage to be measured determines which scale to use. When making voltage measurements always start on a high range and work down. Make the final reading at mid-scale or higher for greater accuracy. You will also note that the **RANGE** switch is marked with numbers which are multipliers for all of the voltage scales.

The next two scales (red) are marked **P-P**, or peak-to-peak. The peak value of a sine wave is 1.414 times the rms value. Therefore, peak-to-peak values are 2.83 times rms. Peak-to-peak values are read directly on the two red scales. The first red scale, marked 0-40, corresponds to the first black scale. This is indicated on the meter face by 15 R.M.S. in parenthesis. The second red scale corresponds to the second black scale and is similarly marked 50 R.M.S. As an example, suppose the **RANGE** switch is set at 15V and an AC voltage of 10 volts rms is to be measured. The meter needle will stop at 10 on the rms scale. At the same

time you can read the peak-to-peak value of the sine wave on the corresponding P-P scale, or 28.3 volts. No calculations are necessary to convert rms to peak-to-peak or vice versa. Greater accuracy is assured as well as saving you time. Peak-to-peak voltages are used for waveform measurements such as are encountered in television service work.

The use of the decibel scale and zero center are explained in the section of this manual "USING YOUR VTVM".

## CALIBRATION

Before you calibrate your VTVM, be sure the meter needle is at zero on the left side of the scale.

- ( ) Turn the instrument off. If the needle is not at zero, adjust the screw above the pilot light. Turn the zero-adjustment screw either right or left as required to bring the meter needle to zero.

Turn the instrument on again.

- ( ) Set the FUNCTION switch, S-2, to the +DC position. Adjustment of the ZERO ADJUST control should move the needle approximately one-half scale. Reset the ZERO ADJUST control for zero. Set S-2 to the —DC position. If there is any change in the zero, re-adjust the ZERO ADJUST control. Repeat this procedure until there is no change in the zero when the FUNCTION switch is changed back and forth from +DC to —DC.

## DC CALIBRATION

Insert the black pin jack into the common plug.

Attach the DC volts test cable to the connector on the front panel.

Set the FUNCTION switch to +DC.

Set the RANGE switch to 1.5 volts.

Use the battery which is included with your VTVM.

Attach the DC test prod to the positive end of the battery and the common test lead to the negative end of the battery.

Adjust R-29, the DC calibrate control on the printed circuit board, so that the needle of the meter rests exactly over the red dot at the extreme right edge of the scale.

Set the FUNCTION switch to —DC.

Connect the test leads to the battery in opposite polarity.

There should be no change in the position of the needle over the red dot. If there is, adjust the DC calibrate control until there is no change when switching back and forth from +DC to —DC.

## AC CALIBRATION

Set the FUNCTION switch to AC volts.

Insert the AC-OHMS pin jack into the red pin plug.

Let the leads hang free. DO NOT hold them to eliminate any hum pickup.

Set the RANGE switch to 1.5 volts.

Adjust R-34, the AC Balance Control on the printed circuit board, so that the meter needle reads exactly zero on the left side of the scale.

Set the RANGE switch to 15 volts.

Touch the AC-OHMS test prod to the green lead of T-1, which is not grounded.

The common test prod is already grounded to complete the circuit.

Adjust R-26, the AC Calibrate Control on the printed circuit board, for 6.3 volts.

You also can make this adjustment by measuring the voltage between the two connections of the line cord.

Set the RANGE switch to 150 volts.

Adjust the AC Calibrate Control for 117 volts.

## OHMS CALIBRATION

Turn off the VTVM.

Install the battery on the printed circuit board.

Turn the VTVM on.

Set the FUNCTION switch to ohms.

Adjust R-25 for full scale.

Touch the AC-OHMS and COMMON test leads together. The meter needle should indicate zero ohms.

## FINAL ASSEMBLY

- ( ) Install the meter in the case so that the clamp at the top of the panel hooks against the inside of the flange in the case
- ( ) Use the two self-tapping screws through the holes in the panel. Tighten them into the holes in the case.

## HOW THE KNIGHT VTVM WORKS

### SEE FIGURE 16.

The KNIGHT VTVM utilizes the basic principle of a vacuum tube which is: A tube can amplify without taking power from the voltage source applied to its grid. This instrument is extremely sensitive and stable because every measurement is made electronically.

A sensitive 200 microampere meter is the indicating component. The meter is in the cathode circuit of the 12AU7 twin triode tube, V-2. R-27, the zero adjust control, balances the two sections of the tube so that



there is no indication on the meter due to both sections of the control being equal when there is no applied voltage. When a voltage to be measured is fed into the grid of V-2, this balance is upset and the voltage can be read directly on the meter. The test voltage and the meter indicating current are directly proportional, so that the meter is calibrated directly. The meter is protected, because as stated before, the voltage to be measured is applied to the tube rather than the meter.

The test voltage applied to the tube is a maximum of 3 volts. Higher test voltages are reduced through the voltage divider with a total resistance of 10 megohms. The DC test prod includes a 1 megohm resistance in addition. The high input impedance of the VTVM enables you to make measurements in most circuits without disturbing the circuits.

When the instrument is used for making AC measurements, the 6AL5 tube, V-1, acts as a full wave rectifier. The output of this tube is directly proportional to the AC voltage to be measured. The DC output is fed through the voltage divider network the same as for DC measurements and is indicated in exactly the same way.

On the 500 and 1500 volt scales for AC measurements, the voltage to be measured is reduced through R-3 and R-2 before it is applied to V-1. This feature protects V-1 and all following circuitry since voltages greater than 150 volts are not applied to the tube.

The AC scales are calibrated in both RMS and peak-to-peak values.

The AC balance control provides proper meter indication for the applied AC voltage by cancelling out the contact potential between elements of V-1. The contact potential is cancelled out by the bucking voltage provided by the AC balance control. This control permits changing from AC to DC without re-adjusting the zero of the meter.

A 1.5 volt battery is connected through a series of multipliers and the unknown resistance to be measured creating a voltage divider across the battery. Part of the resulting battery voltage is applied to the 12AU7 causing a deflection in the meter. For these measurements the meter is calibrated in ohms.

There are two accessory probes which will make your KNIGHT VTVM an even more versatile instrument. One is the high-voltage probe which extends the range of the instrument to 50,000 volts, when on the 500 volt scale.

The other probe is the high-frequency probe. This probe further permits work in RF circuits up to 250 megacycles, yielding a direct reading in RMS volts.

The stock number of each probe is listed at the end of the Parts List.

## USING YOUR VTVM

**CAUTION: NEVER TOUCH ANY PART OF THE WIRING WHILE THE INSTRUMENT IS PLUGGED INTO AN AC OUTLET. Do not use the VTVM on a grounded metal bench, radiator, or other grounded object.**

Remove the power from the equipment under test before you attach the test leads. If this cannot be done, use SPECIAL CARE not to touch grounded ob-

jects. Use only one hand at a time. Grasp the test prods on the handles, never on the metal tips. Stand on a well insulated floor.

It is a good policy to discharge filter capacitors before test leads are attached.

### DC VOLTAGE MEASUREMENTS

Set the FUNCTION SWITCH to + or — DC volts as required.

Set the RANGE SWITCH to a range higher than the voltage to be measured.

Connect the common test lead.

Touch or connect the DC test prod to the high side of the voltage to be measured.

Reset the RANGE SWITCH to a scale where a reading will be obtained at almost full scale.

Read the DC voltage directly.

### ZERO-CENTER INDICATION

This is a useful feature of the instrument since both the positive and negative DC voltages may be observed without changing the setting of the FUNCTION SWITCH.

Set the FUNCTION SWITCH to +DC or —DC volts, whichever gives zero centering of the meter needle. Either position may be used. The two sections of the 12AU7 may be slightly different so that zero center may not be obtained in both positions.

Rotate the ZERO ADJUST control so that the needle of the meter is at the center "0".

Set the RANGE SWITCH to a range at least twice that to be measured.

After the voltage has been tested, set the RANGE SWITCH to the lowest scale which allows the needle to stay on the scale.

When you have completed the measurement, reset the meter needle to the zero at the left of the scale.

### AC VOLTAGE MEASUREMENT

Set the FUNCTION SWITCH to AC Volts.

Short the common test lead and the AC test lead together, and adjust the ZERO ADJUST control to position the meter needle at zero.

Set the RANGE SWITCH to a position higher than the voltage to be measured.

Connect the common lead to the ground side of the circuit.

Touch the AC-OHMS test lead to the hot side of the circuit.

Reset the RANGE SWITCH for a scale which will give an indication near full scale.

Since the human body picks up AC when near an AC circuit, the sensitivity of the KNIGHT VTVM causes the instrument to indicate this. Therefore, do not hold both test leads when making AC measurements.



## RESISTANCE MEASUREMENTS

Set the FUNCTION SWITCH to ohms.

Set the RANGE SWITCH for the proper value.

Connect the common test lead to one side of the resistor to be measured.

Set the OHMS ADJUST Control so that the meter reads exactly full scale.

Touch the AC-OHMS test prod to the other side of the resistor.

Read the resistance on the ohms scale and multiply by the multiplier indicated by the setting of the RANGE SWITCH.

The instrument must be plugged into an AC power outlet when making resistance measurements as all indications are through the electronic meter circuit. Do not leave the FUNCTION SWITCH in the ohms position when you have completed the resistance measurements as this may greatly shorten the life of the battery.

## DECIBEL MEASUREMENTS

A unit known as the "bel" was adopted as a unit of measurement for sound since the human ear does not respond to volume of sound in proportion to signal strength. The bel is more clearly equivalent to human ratios. The measurement is usually given in 1/10 of a bel which is known as a decibel. The KNIGHT VTVM db scale uses a standard of 1 milliwatt into a 600 ohm line as zero decibels. This corresponds to .774 volts AC on the 0-1.5 volt scale. Using this figure, the AC ranges may be converted to db by the following chart:

AC VOLTS SCALE	DECIBEL SCALE
0-1.5 volts	Read db directly
0-5 volts	Add 10 db to the reading
0-15 volts	Add 20 db to the reading
0-50 volts	Add 30 db to the reading
0-150 volts	Add 40 db to the reading
0-500 volts	Add 50 db to the reading
0-1500 volts	Add 60 db to the reading

For example, when measuring the gain of an amplifier, if the input reading is +4.5 db on the 1.5 volt range and the output reading is -5.5 db on the 500 volt range, the correct reading would be 50 plus 4.5 minus 5.5 or 49 db, which is the algebraic sum.

The decibel is a power or voltage ratio and may be used as such without specifying the reference level. Since this is true, a fidelity curve may be run by feeding in a signal of variable frequency but constant amplitude. At the reference frequency, adjust the input to give a convenient indication (zero db) on the VTVM connected to the output. The output variation may be read directly in db above and below the specified reference level as the input frequency is varied.

However, when measuring complex AC wave shapes, such as ripple, hum, distorted and square waves, the indication is 35% peak-to-peak.

## SPECIAL APPLICATIONS

**OSCILLATOR GRID-BIAS MEASUREMENTS.** Set the FUNCTION SWITCH to DC. Select a suitable

range. Make comparative voltage readings on each band of a multi-band receiver and rotate the main tuning capacitor through each band while measuring the bias.

**AVC-VOLTAGE MEASUREMENTS.** Make this measurement at the diode-load resistor, along the AVC bus, or at the grids of the controlled tubes.

**OUTPUT INDICATION.** Set the FUNCTION SWITCH for DC. Make the measurement with the test prod connected to the load resistor of the second detector in AM and TV receivers while adjusting the components for optimum output. Connect the test prod to the limiter load resistor for an FM receiver.

**BIAS-CELL VOLTAGE MEASUREMENTS.** The low scales of 0-1.5 and 0-5 volts make small voltages easy and convenient to read when bias voltages are critical.

**DETECTION OF GASSY TUBES.** If a tube is gassy and does not show up on a tube tester, the bias voltage will have an abnormal value when checked in an RC-coupled circuit.

## SERVICE HINTS

If you have followed all of the instructions and diagrams carefully, your KNIGHT VTVM should operate properly.

If it does not, recheck all of the wiring carefully. Most difficulties are the result of a wiring error. Often it is helpful to have someone else check the wiring, preferably someone with radio-TV or amateur experience.

Be sure that the shouldered fiber washer is on the inside of the panel on the AC-OHMS jack so that the jack is insulated from the panel. If this jack is not insulated from the panel, the house fuse will blow if you use your house line for calibrating on AC volts; and the needle will deflect fully to the right on OHMS indicating a short.

If a tube does not light, and you are absolutely certain the wiring on its socket is correct, its heater is open. Replace it with another of the same type.

If the tubes light and the instrument still does not operate properly, check each position of the FUNCTION switch and the RANGE switch. Determine if all functions are inoperative, or only one or two.

**If your VTVM does not operate on DC volts, check your probe first. If the probe is open or shorted, there will be no reading on either + or - DC volts on any range.**

If the instrument operates satisfactorily on DC volts and not on AC volts, the 6AL5 tube and its associated circuitry are at fault. If the meter will not zero on AC, check R-34.

If the instrument does not operate on the 500 and 1500 volt AC scales, check R-2 and R-3. If the instrument fails to operate on either AC or DC voltages, check the string of multipliers R-10, R-11, R-12, R-13, R-14, R-15, and R-16.

If the instrument fails to function properly on OHMS, first check the battery. If this is satisfactory, check the string of multipliers R-17, R-19, R-20, R-21, R-22, R-23, and R-24.

If the instrument is erratic in operation, that is varying deflection to the right on +DC volts, varying deflection to the left on -DC volts, and a "wavy"

deflection on AC, the bond between the board and the tube socket pins has probably been broken. Using more solder, again solder the connections.

Should there be no operation whatsoever, check the

### VOLTAGE CHART

All measurements made with vacuum tube voltmeter from pin indicated to panel ground. FUNCTION SWITCH in AC Volts position. RANGE SWITCH in 1.5 volt position.

TUBE	PIN								
	1	2	3	4	5	6	7	8	9
6AL5	*	*	5.4AC	0	0	NC	-		
12AU7	77.0	0	3.5	0	0	77.0	0	3.5	5.4AC

\* Non-significant voltages. NC - Not connected.

### ALLIED'S SERVICE FACILITIES

If the kit still does not operate properly, we recommend the following:

Please write our Kit Department giving stock number and date of purchase of the kit. Also, describe fully what appears to be wrong. Details as to which controls or sections of the circuit do not function properly will help us analyze the problem. We may be able to determine a wiring error or a defective part.

This wired KNIGHT kit may be returned for inspection within 1 year after purchase for a special service charge of \$3.00. However, if the meter movement must be replaced because of burnout or other abuse another \$11.40\* will be charged. Parts within the standard EIA 90-day warranty period will be replaced without charge for the parts. A charge will be made for parts damaged in construction or because of a wiring error, or for parts which are beyond the 90-day warranty period. After the one year period, service charges, plus cost of parts are based on the length of time required to repair the unit.

**PLEASE NOTE: KITS WIRED WITH ACID CORE SOLDER OR ACID FLUX ARE NOT ELIGIBLE FOR REPAIR OR SERVICE AND WOULD HAVE TO BE RETURNED NOT REPAIRED AT YOUR EXPENSE.**

Allied's service facilities are primarily for inspection and trouble-shooting. Kits not completely wired, which require extensive work, will be returned collect with a letter of explanation.

If, for any reason, you desire to ship your VTVM, it is extremely important that you unsolder the six connections on the power transformer, remove the two nuts and screws, and lift the transformer from the printed circuit board. Wrap the transformer separately and pack it outside the case of the VTVM. This will assure no damage to the printed circuit board during shipment. Re-installation is a simple job since the board does not have to be removed for this operation.

If you return this kit, pack it well. To prevent damage in shipment, use a large enough carton so that cushioning material can be placed around the instru-

"D" wafer section of S-2. If this is OK, check the transformer. If the transformer is OK, check the rectifier. If all of the power supply components are satisfactory, the problem is in the 12AU7 or its associated circuitry.

### RESISTANCE CHART

All measurements made with vacuum tube voltmeter from pin indicated to panel ground. FUNCTION SWITCH in off position.

TUBE	PIN								
	1	2	3	4	5	6	7	8	9
6AL5	*	*	1	0	0	NC	110M		
12AU7	20K	*	85K	0	0	20K	10M	85K	1

All values indicate ohms. \*-Infinite. K equals 1000. M equals 1,000,000. NC - Not connected.

ment. Cushion it well and tightly. Mark it: FRAGILE—DELICATE ELECTRONIC INSTRUMENT. Send the kit prepaid and insured. We will return the repaired kit to you C.O.D. as soon as repairs are completed. If you wish to save C.O.D. fees, your advance remittance may be enclosed for standard repair charges plus transportation costs. Any excess remittance will be refunded.

### ALLIED'S GUARANTEE ON KNIGHT KITS

The designs and components selected for KNIGHT kits represent over a quarter of a century of experience in kit development. KNIGHT kits are easy to assemble even for the beginner. Instructions are complete, panels are drilled, the chassis is punched and formed, and every last part is included as listed.

Allied extends these firm guarantees on KNIGHT kits:

We guarantee that the circuits on all KNIGHT kits have been carefully engineered and tested.

We guarantee that only high-quality components are supplied. All parts are covered by the standard EIA 90-day warranty. Any faulty components will be replaced prepaid and without charge if reported to us within the warranty period. We reserve the right to request the return of defective parts.

If your kit was shipped by parcel post and is received in a damaged condition, please write us at once describing the state in which the shipment was received. If your kit was part of a Railway Express shipment that was damaged in transit, please notify the Railway Express agent at once and then write us.

The efficiently engineered KNIGHT kits are moderately priced. When you buy a KNIGHT kit you get the best in design, quality, and value. Recommend KNIGHT kits to your friends.

\* Subject to change.

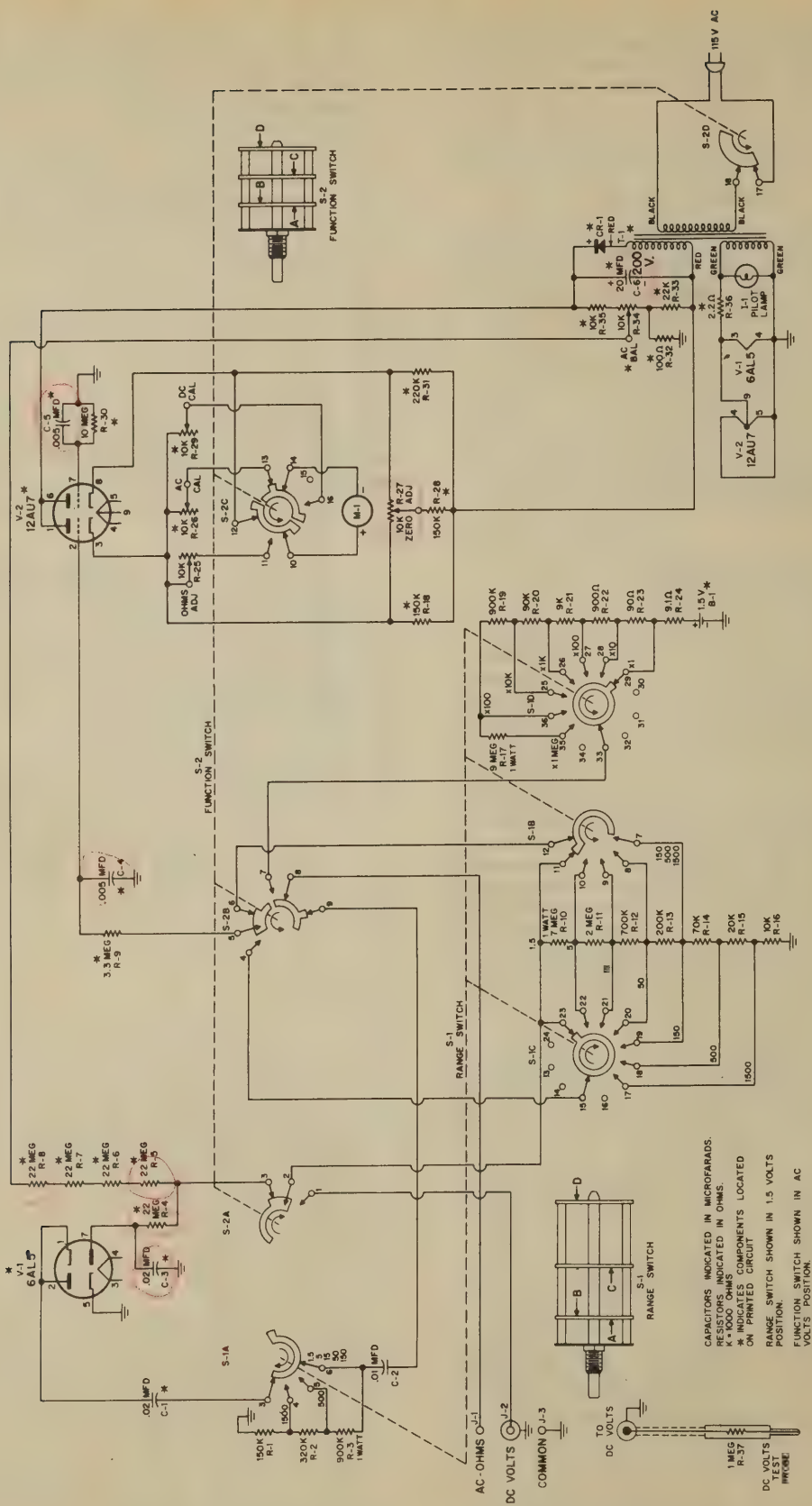


FIGURE 16. SCHEMATIC DIAGRAM, KNIGHT VTVM



# THE KNIGHT VTVM PARTS LIST

Symbol Number	Description	Allied Part No.
✓C-1	Capacitor, Disc, .02 MFD 600V.....	296009
✓C-2	Capacitor, Molded Tubular, .01 MFD 1600V.....	258015
✓C-3	Capacitor, Disc, .02 MFD 600V.....	296009
✓C-4	Capacitor, Disc, .005 MFD 600V.....	296000
✓C-5	Capacitor, Disc, .005 MFD 600V.....	296000
✓C-6	Capacitor, Tubular Electrolytic, 20 MFD 200V.....	293007

Note: When ordering resistors, give complete description and part number.

✓R-1	Resistor, 150K - ½W, ±1% .....	341503
✓R-2	Resistor, 320K - ½W, ±1% .....	343203
✓R-3	Resistor, 900K - 1W, ±1% .....	359003
✓R-4	Resistor, 22 Megohm, ½W, ±10% .....	301226
✓R-5	Resistor, 22 Megohm, ½W, ±10% .....	301226
✓R-6	Resistor, 22 Megohm, ½W, ±10% .....	301226
✓R-7	Resistor, 22 Megohm, ½W, ±10% .....	301226
✓R-8	Resistor, 22 Megohm, ½W, ±10% .....	301226
✓R-9	Resistor, 3.3 Megohm, ½W, ±10% .....	301335
✓R-10	Resistor, 7 Megohm, 1W, ±1% .....	357004
✓R-11	Resistor, 2 Megohm, ½W, ±1% .....	342004
✓R-12	Resistor, 700K - ½W, ±1% .....	347003
✓R-13	Resistor, 200K - ½W, ±1% .....	342003
✓R-14	Resistor, 70K - ½W, ±1% .....	347002
✓R-15	Resistor, 20K - ½W, ±1% .....	342002
✓R-16	Resistor, 10K - ½W, ±1% .....	341002
✓R-17	Resistor, 9 Megohm, 1W, ±1% .....	359004
✓R-18	Resistor, 150K - ½W, ±10% .....	301154
✓R-19	Resistor, 900K - ½W, ±1% .....	349003
✓R-20	Resistor, 90K - ½W, ±1% .....	349002
✓R-21	Resistor, 9K - ½W, ±1% .....	349001
✓R-22	Resistor, 900 ohm, ½W, ±1% .....	349000
✓R-23	Resistor, 90 ohm, ½W, ±1% .....	340900
✓R-24	Resistor, 9.1 ohm, ½W, 5% Wirewound.....	312090
✓R-25	Potentiometer, 10K ohm, Carbon Pot, Linear Taper .....	390112
✓R-26	Potentiometer, 10K ohm, Carbon Pot, Linear Taper .....	390113
✓R-27	Potentiometer, 10K ohm, Carbon Pot, Linear Taper .....	390112
✓R-28	Resistor, 150K - ½W, ±10% .....	301154
✓R-29	Potentiometer, 10K ohm, Carbon Pot, Linear Taper .....	390113
✓R-30	Resistor, 10 Megohm, ½W, ±10% .....	301106
✓R-31	Resistor, 220K - ½W, ±10% .....	301224
✓R-32	Resistor, 100 ohm, ½W, 20% Carbon .....	300101
✓R-33	Resistor, 22K - ½W, ±10% .....	301223
✓R-34	Potentiometer, 10K ohm, Carbon Pot, Linear Taper .....	390113
✓R-35	Resistor, 10K - ½W, ±10% .....	301103
✓R-36	Resistor, 2.2 ohm, ½W, 5% Wirewound.....	312020
✓R-37	Resistor, 1 Megohm, ½W, ±5% .....	302105
✓S-1	Switch, Range, 3 Section, 7 Position.....	432301
✓S-2	Switch, Function, 3 Section, 5 Position.....	432300
✓T-1	Transformer, Power .....	101301
✓V-1	Tube, 6AL5 .....	611005
✓V-2	Tube, 12AU7 .....	611001
✓I-1	Pilot Bulb, #47.....	640002
✓J-1	Jack insulated red tip .....	502211
✓J-2	Cable Connector, Chassis Mtg. ....	502122
	consists of:	
	1 Washer, flat fiber .....	590701
	1 Solder lug .....	553003
	1 Washer, flat metal .....	580702
	1 Nut .....	570850
✓J-3	Jack, Insulated Black Tip.....	502212
✓M-1	Meter, 200 μAmp. ....	654201
✓CR-1	Rectifier, Selenium, 50 MA. ....	621001
✓B-1	Battery, Type 1 Size "C".....	450011

Description	Quantity	Allied Part No.
Assembly, Pilot Light .....	1	040011
consists of:		
1 Bracket .....		501721
1 Jewel .....		641002
1 Nut, 5/16" .....		579401
Battery Clip Board .....	1	534001
Cable, 9 Conductor .....	11"	803003
Cable, Shielded .....	48"	803001
Case .....	1	700003
Circuit Board, Printed Wiring .....	1	820007
Clamp, Cable .....	2	532001
Clip, Alligator .....	1	532005
Clip, Battery Retaining .....	1	534002
Connector, Cable .....	1	502224
Control Nut, Hex, ¾" .....	8	570840
Cord, Line .....	1	802001
Instruction Manual .....	1	750009
Knob, ¾" Dia. ....	2	760000
Knob, 1" Dia. ....	2	760100
Leather Handle, Black.....	1	920001
Nut, 4-36 Hex .....	2	570230
Nut, 6-32 Hex .....	3	570340
Nut, 10-32 Hex .....	2	570540
Panel .....	1	462204
Plug, Insulated Black Tip .....	1	502112
Plug, Insulated Red Tip .....	1	502111
Prod, Black Test .....	1	880002
Prod, Red Test .....	1	880001
Screw, 4-36 x ¾" B.H. ....	1	560234
Screw, 4-36 x ¼" Flat Head .....	1	563232
Screw, 6-32 x ¼" B.H. ....	2	560342
Screw, 6-32 x ½" .....	1	560343
Screw, #4 Pan Head, Self Tap. ....	2	562232
Sleeve, 1¾" Long Spacer .....	4	470007
Socket, 7-pin Printed Circuit Miniature .....	1	501671
Socket, 9-pin Printed Circuit Miniature .....	1	501691
Solder, rosin core.....	48"	930001
Spaghetti, Small .....	7"	812001
Spaghetti, Large .....	7"	812003
Studs, Handle Mtg. ....	2	470025
Washer, Fiber, Flat #6 .....	3	590300
Washer, #6 Flat Steel .....	1	580200
Washer, #10 Flat Steel .....	2	580501
Washer, ¾" Lock .....	2	582700
Washer, External Tooth #6 Lock .....	1	583300
Washer, Internal Tooth #6 Lock .....	2	582300
Washer, Internal Tooth #10 Lock .....	2	582500
Wire, Red Hookup, 2" .....	5	801002
Wire, Orange Hookup, 3" .....	2	801003
Wire, Yellow Hookup, 4" .....	2	801004
Wire, Green Hookup, 5" .....	5	801005
Wire, Blue Hookup, 6" .....	2	801006
Wire, Violet Hookup, 7" .....	2	801007
Wire, #20 Bare Hookup .....	13"	806013
Wire, Rubber Covered Black Test Lead .....	48"	804019
Wire, Rubber Covered Red Test Lead .....	48"	804020

## TOOLS NEEDED FOR CONSTRUCTION

Allied Stock No.	Description	Price*
46N852	Soldering pencil .....	\$5.26
50N132	6" long nose pliers .....	1.54
45N796	6" screwdriver .....	.72
50N133	5" diagonal cutters .....	1.34

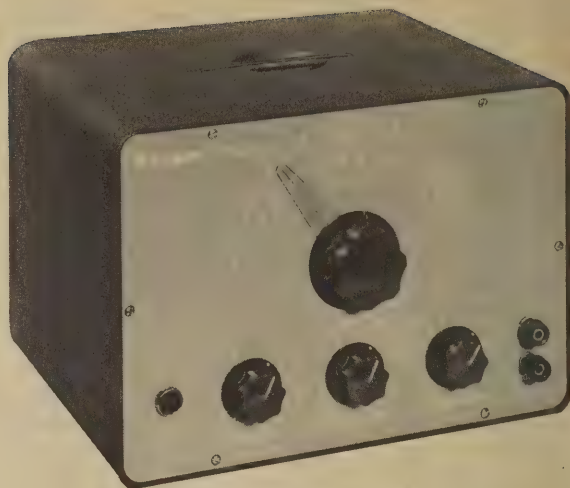
\* Subject to change.

## ACCESSORIES YOU MAY WANT

Allied Stock No.	Description
83Y126	High-Voltage Probe
83Y127	RF Probe



**knight-kit**  
**RF SWEEP GENERATOR KIT**  
**83 YX 123**



**knight-kit**  
**AUDIO GENERATOR KIT**  
**83 YX 137**

All new TV-FM sweep generator kit—a precision instrument designed for lab use, TV and FM servicing, production line testing, and electronic training. Top features are: An exclusive sweep system designed for high accuracy and linearity; electronic retrace blanking; and an automatic gain control circuit to keep the output voltage constant over the swept range on all bands.

With all parts, tubes, pre-cut wire, test cables, solder, and step-by-step instructions with pictorial and schematic diagrams, less crystal.

Latest circuit as developed by U.S. Bureau of Standards. Performance equals or surpasses far costlier factory-built units. Provides an audio source for checking high-fidelity amplifiers and other audio equipment. Also excellent for checking speaker response. Step attenuated output continuously variable between steps. Permits selecting the exact drive voltage for testing all types of audio systems. Complete with all parts, tubes, pre-cut wire, solder, and step-by-step instructions.

#### **SPECIFICATIONS**

Frequency Range: 300 KC to 250 MC in four bands  
 RF Sweep Output: Not less than .15 volts, regulated within 1 db over swept range on all bands  
 Sweep Frequency: 60 cps  
 Sweep Width: 0 to 13 MC  
 Marker: Internal crystal oscillator with dual crystal socket and selector switch (crystals not included)  
 Horizontal Sweep Voltage: 5 volts RMS, 60 cps  
 Phase Control: Blanking shift, 0 to 180 degrees  
 Output Controls: Step and fine controls for RF output. Separate marker amplitude control  
 Tube Complement: 6BQ7A sweep osc. and mixer; 6J6 variable-freq. osc.; 12AU7 blanking circuit; 6AQ5 series voltage regulator; 6AU6 regulator control; 12AT7 marker osc. and 6X5 rect.  
 Power Consumption: 45W at 115V 60C—AC only  
 Dimensions: 12" x 8½" x 7½"  
 Weight: 13½ lbs.

#### **SPECIFICATIONS**

Oscillator Circuit: Sulzer bridged-T, developed at National Bureau of Standards  
 Frequency Range: 20 cycles to 1 megacycle in 5 bands  
 Output Voltage: Continuously variable. 0 to 10 volts RMS into 600 ohms. Flat within  $\pm 1$ db over entire range  
 Output Source Impedance: 200 ohms  
 Distortion: Less than 0.3% over entire audio spectrum at full rated output  
 Output Circuit: Cathode follower  
 Tube Complement: 6CB6 oscillator; 6CL6 amplifier; 6CL6 output; and 5Y3GT rectifier  
 Power Source: 105 to 125 volts RMS, 50 to 60 cycles AC only  
 Shipping Weight: 17 lbs.  
 Dimensions: 8½" x 11" x 7½"

KNIGHT VTVM

**ALLIED RADIO**  
CORPORATION



100 N. WESTERN AVE. • CHICAGO 80, ILL.

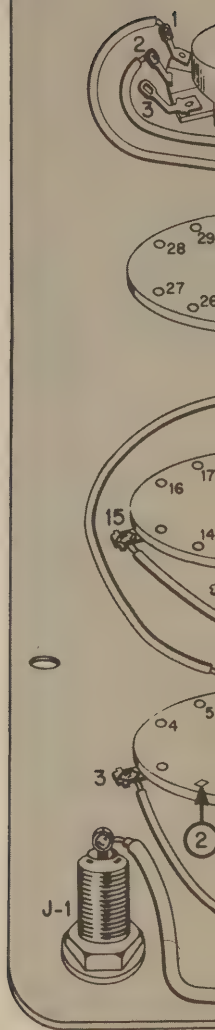


FIGURE 13. CONNEC





**knight-kit**  
**RF SWEEP GENERATOR KIT**  
**83 YX 123**



**knight-kit**  
**AUDIO GENERATOR KIT**  
**83 YX 137**

All new TV-FM sweep generator kit—a precision instrument designed for lab use, TV and FM servicing, production line testing, and electronic training. Top features are: An exclusive sweep system designed for high accuracy and linearity; electronic retrace blanking; and an automatic gain control circuit to keep the output voltage constant over the swept range on all bands.

With all parts, tubes, pre-cut wire, test cables, solder, and step-by-step instructions with pictorial and schematic diagrams, less crystal.

Latest circuit as developed by U.S. Bureau of Standards. Performance equals or surpasses far costlier factory-built units. Provides an audio source for checking high-fidelity amplifiers and other audio equipment. Also excellent for checking speaker response. Step attenuated output continuously variable between steps. Permits selecting the exact drive voltage for testing all types of audio systems. Complete with all parts, tubes, pre-cut wire, solder, and step-by-step instructions.

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 Horizontal Sweep Voltage: 5 volts RMS, 60 cps  
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 Power Consumption: 45W at 115V 60C—AC only  
 Dimensions: 12" x 8½" x 7½"  
 Weight: 13½ lbs.

### SPECIFICATIONS

Oscillator Circuit: Sulzer bridged-T, developed at National Bureau of Standards  
 Frequency Range: 20 cycles to 1 megacycle in 5 bands  
 Output Voltage: Continuously variable. 0 to 10 volts RMS into 600 ohms. Flat within ±1db over entire range  
 Output Source Impedance: 200 ohms  
 Distortion: Less than 0.3% over entire audio spectrum at full rated output  
 Output Circuit: Cathode follower  
 Tube Complement: 6CB6 oscillator; 6CL6 amplifier; 6CL6 output; and 5Y3GT rectifier  
 Power Source: 105 to 125 volts RMS, 50 to 60 cycles AC only  
 Shipping Weight: 17 lbs.  
 Dimensions: 8½" x 11" x 7½"

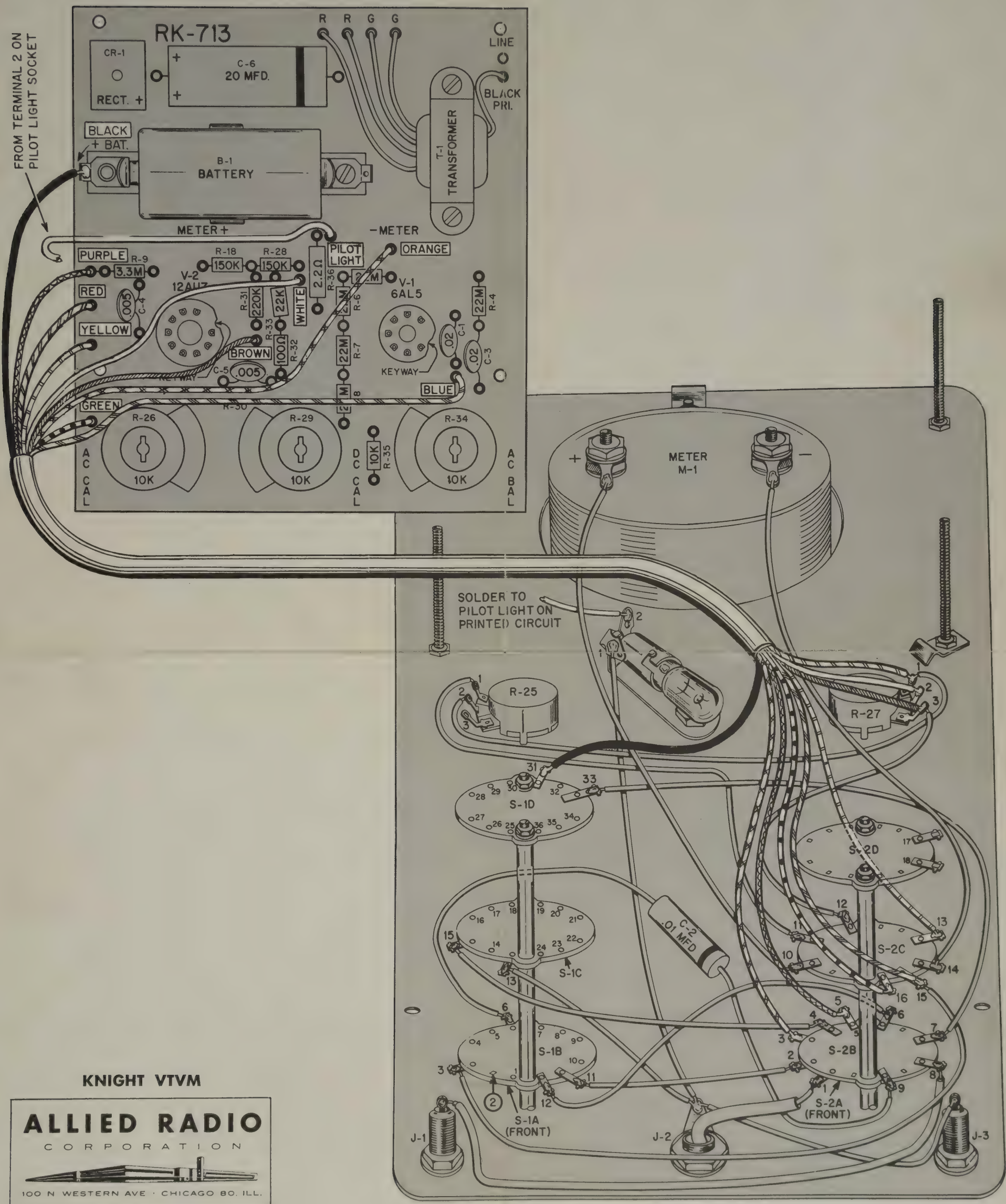
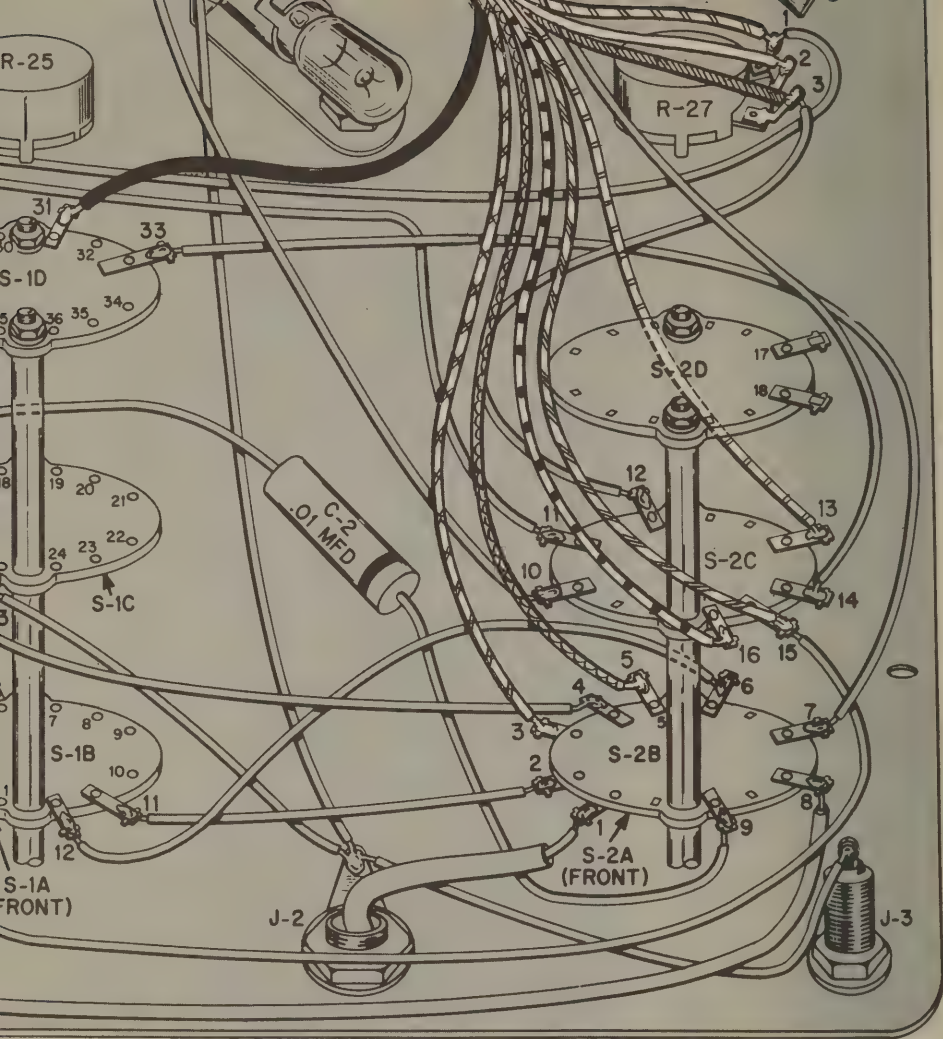


FIGURE 13. CONNECTING THE CABLE





ING THE CABLE



# THE knight-kit<sup>®</sup> HIGH-VOLTAGE PROBE



**ALLIED RADIO**  
CORPORATION



100 N. WESTERN AVE. • CHICAGO 80, ILL. HAYMARKET 1-6800



NOTE  
SWITCHES ARE SHOWN  
EXPANDED AND SIMPLIFIED

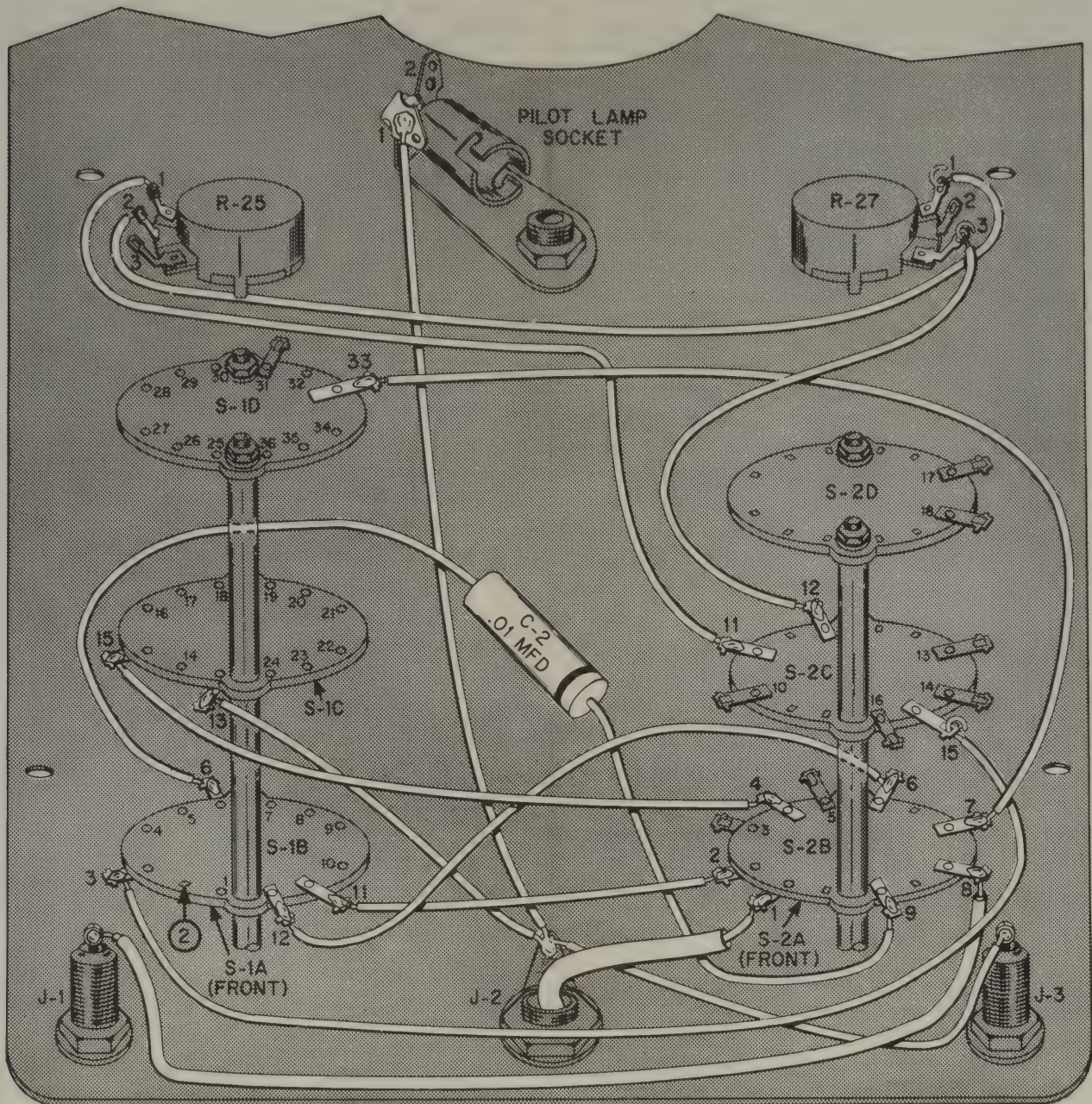


FIGURE 8. HOW TO WIRE THE PANEL

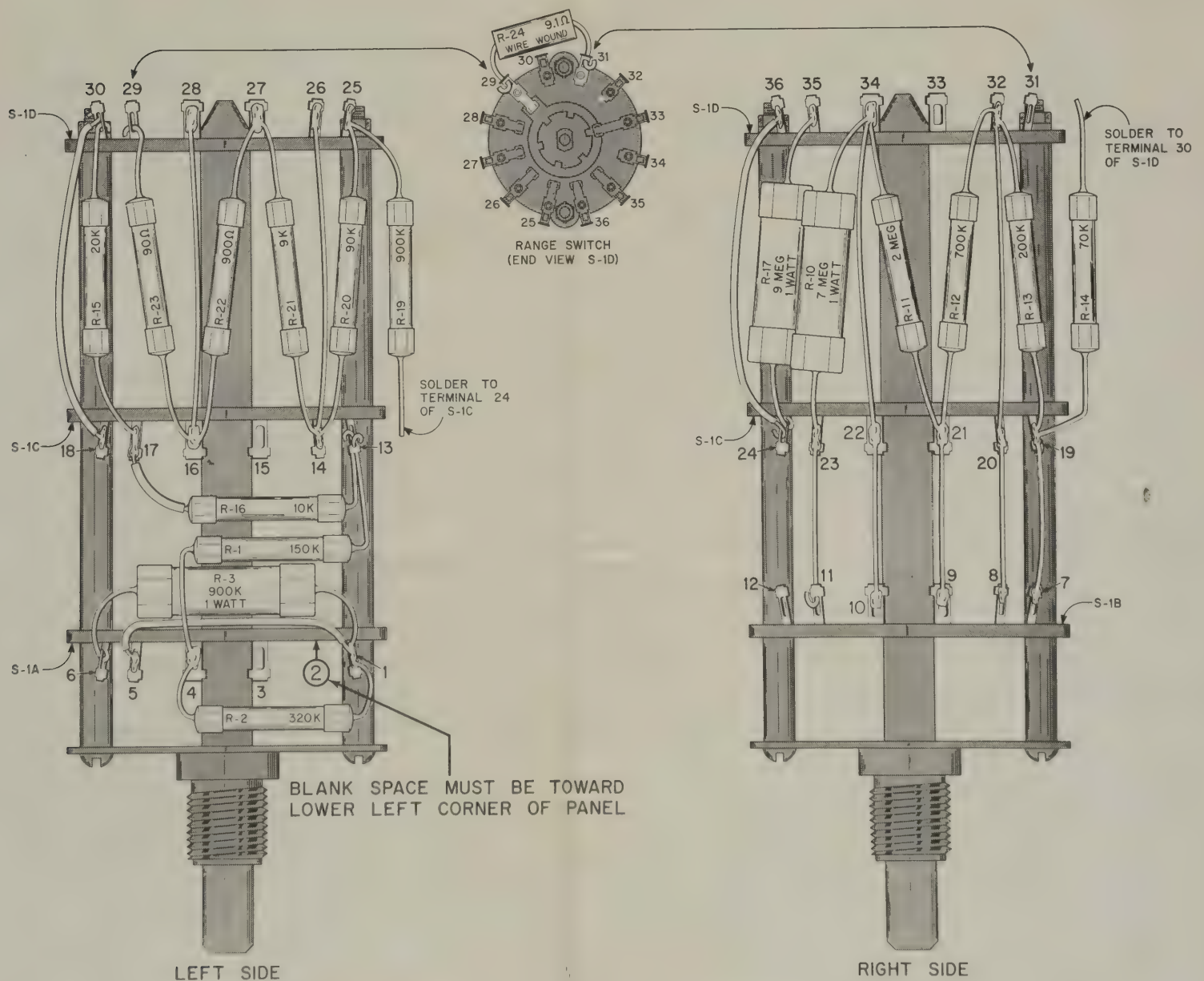


FIGURE 7. HOW TO WIRE THE RANGE SWITCH



# THE knight-kit<sup>®</sup> HIGH-VOLTAGE PROBE



**ALLIED RADIO**

C O R P O R A T I O N



100 N. WESTERN AVE. • CHICAGO 80, ILL. HAYMARKET 1-6800



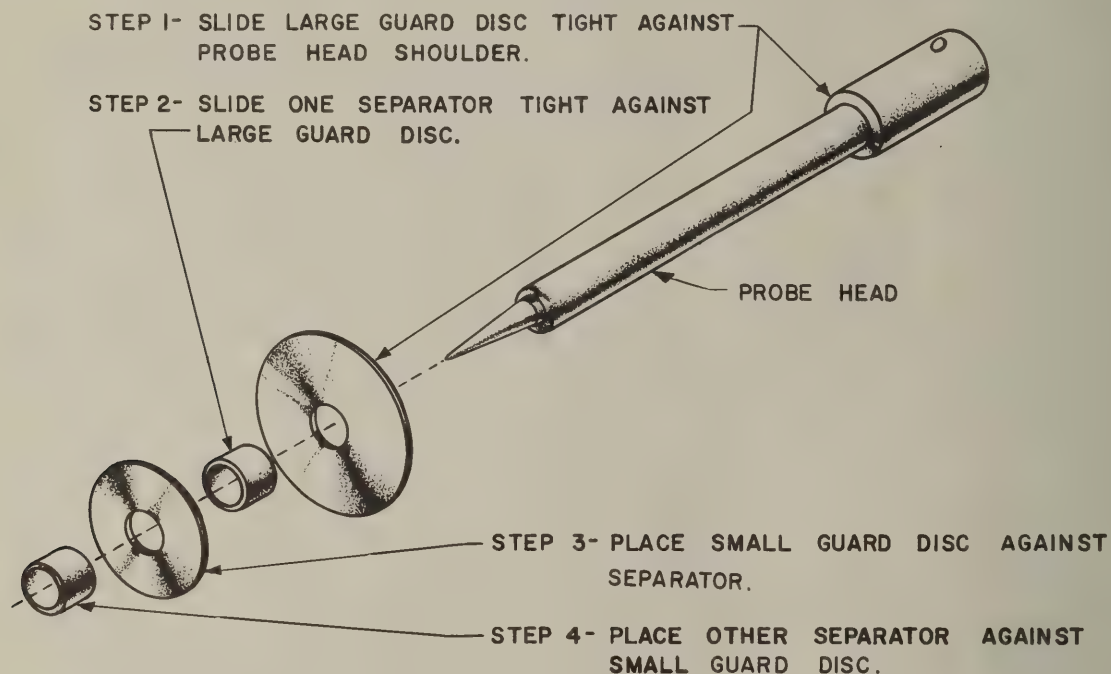
## INTRODUCTION

The High-Voltage Probe extends the range of your VTVM to 50,000 volts on the 500 volt range. Using this probe increases the versatility of the instrument and enables it to measure the high DC voltages in all TV sets, most industrial equipment, transmitters, and other more specialized equipment.

The probe housing is a multi-purpose type. It can be used with both the RF Probe and the High-Voltage Probe Heads. It is shielded, and the connecting cable is flexible and shielded. The probe head has guard discs for protection.

When you unpack your kit, check all of the parts against the Parts List. Study the diagrams to understand the assembly of the parts.

**USE ONLY ROSIN CORE SOLDER. KITS WIRED WITH ACID CORE SOLDER OR ACID FLUX WILL CORRODE AND WILL NOT WORK LONG. SUCH KITS ARE NOT ELIGIBLE FOR REPAIR OR SERVICE.**



**FIGURE 1. MOUNTING THE GUARD DISCS AND SEPARATORS**

### SEE FIGURE 1.

- ✓ As shown in Figure 1, place the large guard disc tightly against the shoulder of the probe head. Next, slide a separator tightly against the large disc, then the small guard disc, and finally the other separator. Be sure all are forced tightly together.

### SEE FIGURE 2.

- ✓ Bend the three pins of the 3-pin socket toward the center of the socket. Solder them together to form a firm base for one end of the spring.

- ✓ Insert R-1, 1090 meg $\Omega$  resistor, into the probe head.
- ✓ Place the spring against the resistor.
- ✓ Remove the retaining screw. Place the socket against the spring and force it into the probe head until the retaining-screw holes in both the probe head and the socket line up. Insert and tighten the screw.



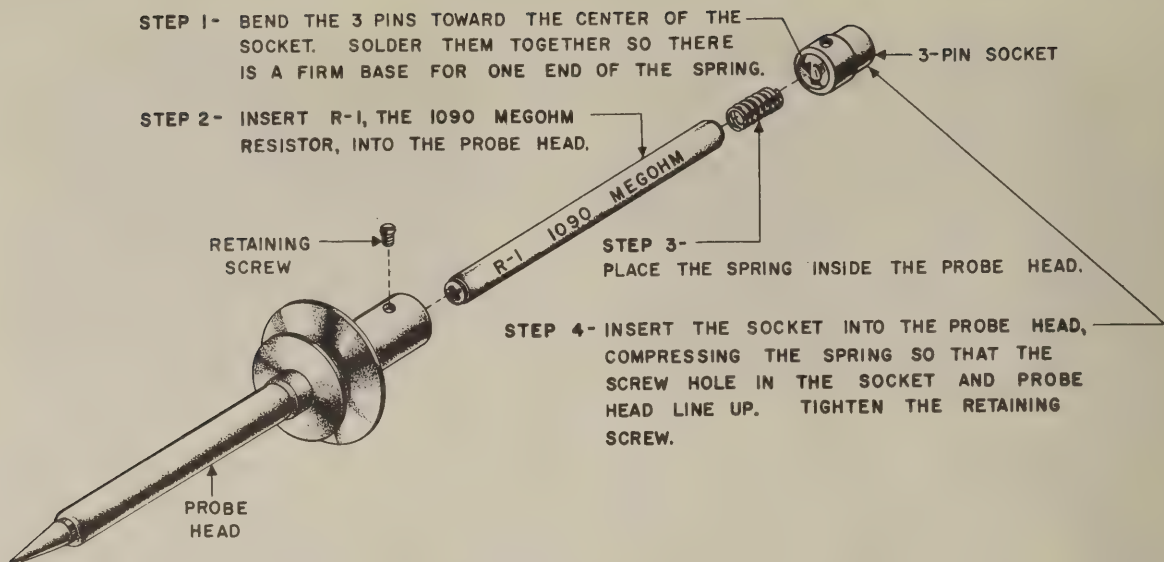


FIGURE 2. PROBE HEAD ASSEMBLY

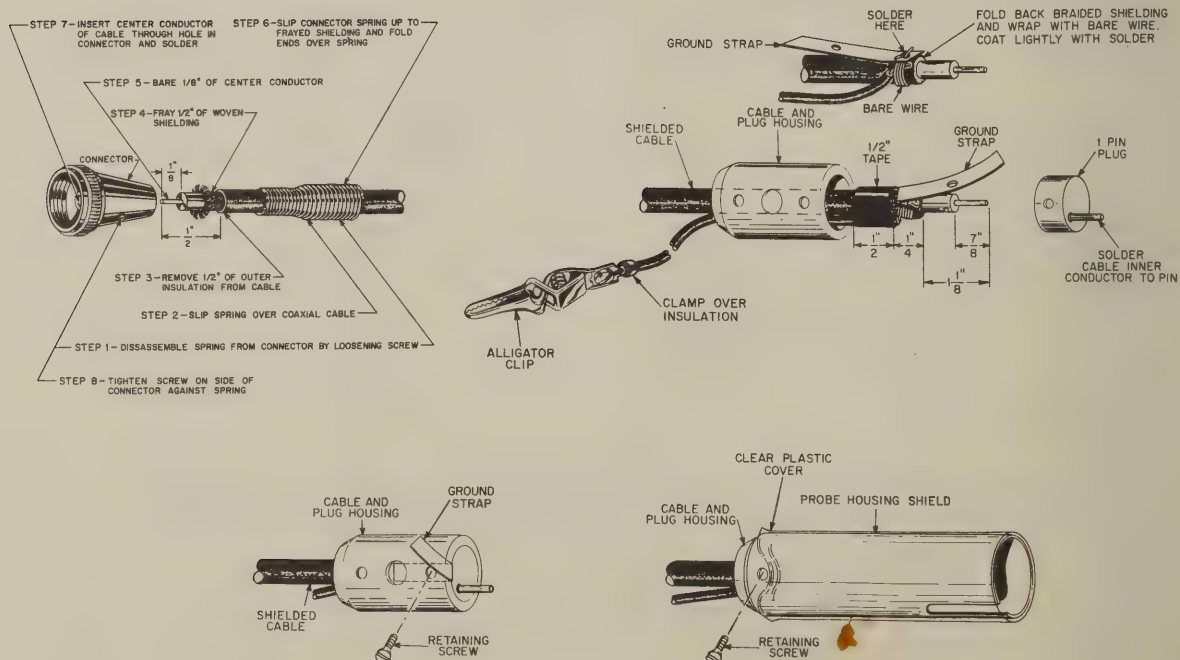


FIGURE 3. CABLE ASSEMBLY



## SEE FIGURE 3.

- ☒ Attach the connector to one end of the cable as shown in Figure 3.
- ☒ Place the cable and plug housing over the other end of the cable. From the end of the cable remove  $1\frac{1}{8}$ " of the outer insulation. Unravel the shielding and fold it back over the cut-off insulation.
- ☒ Remove about  $\frac{1}{4}$ " of insulation from both ends of the 12" ground wire. Hold one end of the ground wire on the shielding. Take the bare wire and wrap 3 turns around the shielding and the bare end of the ground wire.
- ☒ Place the small hole of the ground strap over the two ends of the bare wire.
- ☒ Coat the end of the ground strap, the bare wire, and the shielding with solder. Be careful not to apply too much heat or the insulation around the inner conductor will melt.
- ☒ Remove  $\frac{7}{8}$ " of the insulation from the inner conductor. Insert the inner conductor into the pin of the 1-pin plug, and solder it.
- ☒ Fold the ground strap back toward the 1-pin plug, and line up the center hole in the ground strap with the hole in the plug.
- ☒ Remove the tape wrapped around the probe housing shield. Wrap the tape around the cable and ground lead. Insert the ground lead through the slotted hole in the end of the cable and plug housing.
- ☒ Slide the cable and plug housing down onto the plug. Line up the hole in the end of the cable and plug housing with the holes in the ground strap and the plug. Tighten a retaining screw into this hole. Bend the ground strap back.
- ☒ Insert the cable and plug housing into the probe housing shield. Push back the plastic cover and fasten the parts together with a retaining screw.
- ☒ Connect the free end of the ground lead under the screw on the alligator clip. Clamp the two small lugs, on the end of the clip, down on the wire's insulation.

## FINAL ASSEMBLY

Insert the probe head assembly into the probe shield. The pin on the plug inside the shield must fit into one of the holes of the socket on the probe head.

The cable and its attached components may be used with other probe heads. All that is necessary is to remove the Hi-Voltage Probe Head and insert the one desired.

## USING THE PROBE

**CAUTION:** *The High-Voltage Probe cable shielding must always be grounded. If this is not done the entire VTVM case will be "hot". This condition may result in a serious shock hazard. A safe habit is to keep one hand in your pocket while making measurements. Always hold the probe housing shield — NEVER grasp the probe on or near the guard discs or on the head of the probe.*

The High-Voltage Probe may be used to measure DC voltages up to 50,000 volts. Actually, the resistor in the probe serves as a 100:1 multiplier. Each range of the VTVM is extended 100 times. The probe multiplier resistor is in series with the input string of multipliers of the VTVM, which maintains the isolation of the meter from the voltage to be measured.

Remove the DC test prod from the VTVM. Attach the cable of the High-Voltage Probe to the VTVM. Connect the probe ground lead to the same ground to which the common lead of the VTVM is connected. Adjust the VTVM switch for the proper DC voltage range. Apply power to the equipment under test, and touch the probe tip to the desired measurement location.

A few of the more common uses for a High-Voltage Probe are: Measurement of high DC voltages where AC pulses are present. In such cases, the probe acts as a low-pass filter. An example of such an application is the voltage at the plate of a horizontal output tube in a TV receiver. Another application is the measurement of low voltages in high-resistance circuits, such as measuring the grid bias of the vertical blocking oscillator in a TV receiver.

## ALLIED'S SERVICE FACILITIES

If the probe does not operate properly, please write our Kit Department, giving the stock number, and date of purchase of the kit. Also, describe fully what appears to be wrong. Details as to which sections of the circuit do not function properly will help us analyze the problem. We may be able to determine an error or a defective part.

This wired KNIGHT kit may be returned for inspection within one year from the date of purchase for a special service charge of \$1.00. Parts within the standard RETMA 90-day warranty period will be replaced without charge for the parts. A charge will be made for parts damaged in construction, or because of a wiring error, or for parts which are beyond the 90-day warranty period. After the one-year period, service charges are based on the length of time required to repair the unit plus the cost of any new parts that may be needed.

**PLEASE NOTE: KITS WIRED WITH ACID CORE SOLDER OR ACID FLUX ARE NOT ELIGIBLE FOR REPAIR OR SERVICE AND WILL HAVE TO BE RETURNED AT YOUR EXPENSE.**

Allied's service facilities are primarily for inspection and troubleshooting. Kits not completely wired, which require extensive work, will be returned collect with a letter of explanation.

If you return this kit, pack it well. To prevent damage in shipment, use a large enough carton so that cushioning material can be placed around the unit. Cushion it well and tightly. Mark the carton, "FRAGILE - DELICATE ELECTRONIC INSTRUMENT". Send the kit prepaid and insured. We will return the repaired kit to you C.O.D. as soon as repairs are completed. If you wish to save C.O.D. fees, your advance remittance may be enclosed to cover the standard repair charges plus transportation costs. Any excess money will be refunded.

## ALLIED'S GUARANTEE ON KNIGHT KITS

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If your kit was shipped by parcel post and is received in a damaged condition, please write to us at once describing the state in which the shipment was received. If your kit was part of a Railway Express shipment that was damaged in transit, please notify the Railway Express agent at once and then write us.

The efficiently engineered KNIGHT kits are moderately priced. When you buy a KNIGHT kit you get the best in design, quality, and value. Recommend KNIGHT kits to your friends.

## PARTS LIST

Symbol Number	Description	Stock Number	Description	Quantity	Stock Number
R-1	Resistor, 1090 ohm, 5%.....	333001 ✓	Plug, 1-pin .....	1	502130 ✓
			Screw, retaining, 4-36 x 1/4".....	3	563230 ✓
			Separator .....	2	870022 ✓
Description	Quantity	Stock Number	Socket, 3-pin .....	1	502230 ✓
Cable, RG-58/U .....	48"	803001 ✓	Solder, rosin core.....	6"	930006 ✓
Clip, alligator .....	1	532005 ✓	Spring .....	1	470066 ✓
Connector, cable-type .....	1	502224 ✓	Strap, ground .....	1	470048 ✓
Disc, guard, large.....	1	870020 ✓	Tape .....	4"	811001 ✓
Disc, guard, small.....	1	870021 ✓	Wire, #18 stranded.....	12"	804004 ✓
Head, probe, with tip.....	1	870019 ✓	Wire, #20 bare.....	2"	806002 ✓
		(470065)			
Housing, probe, with shield.....	1	470052 ✓	<b>ANOTHER ACCESSORY YOU MAY WANT</b>		
Housing, cable and plug.....	1	870016 ✓	Stock No.	Description	Price*
Manual, instruction .....	1	750065	83Y127	RF Probe Kit.....	\$3.45

\*Subject to change.

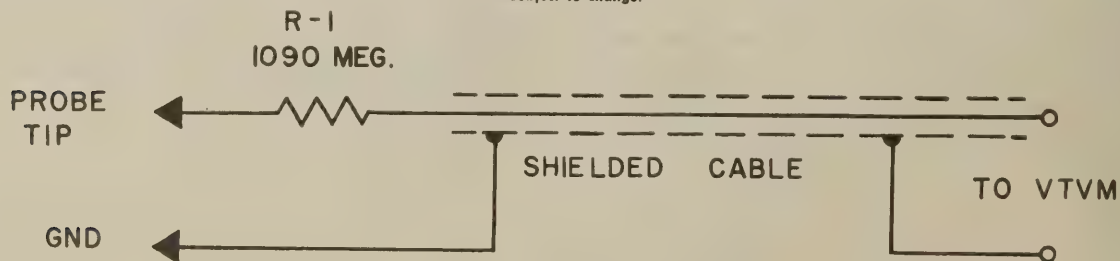


FIGURE 4. SCHEMATIC DIAGRAM



**knight-kits**

# Allied knight®-kit RF PROBE

83 Y 127



**ALLIED RADIO**

C O R P O R A T I O N



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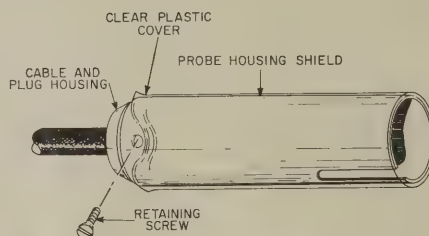
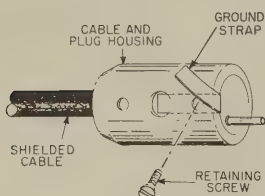
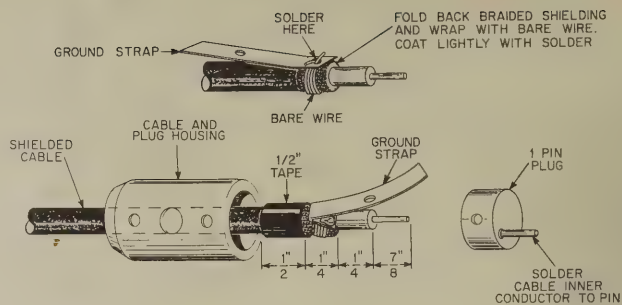
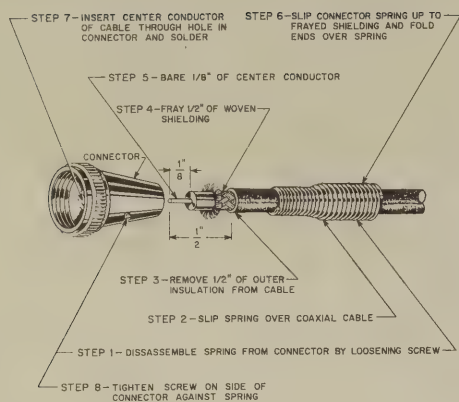


FIGURE 1. HOW TO PREPARE THE CABLE

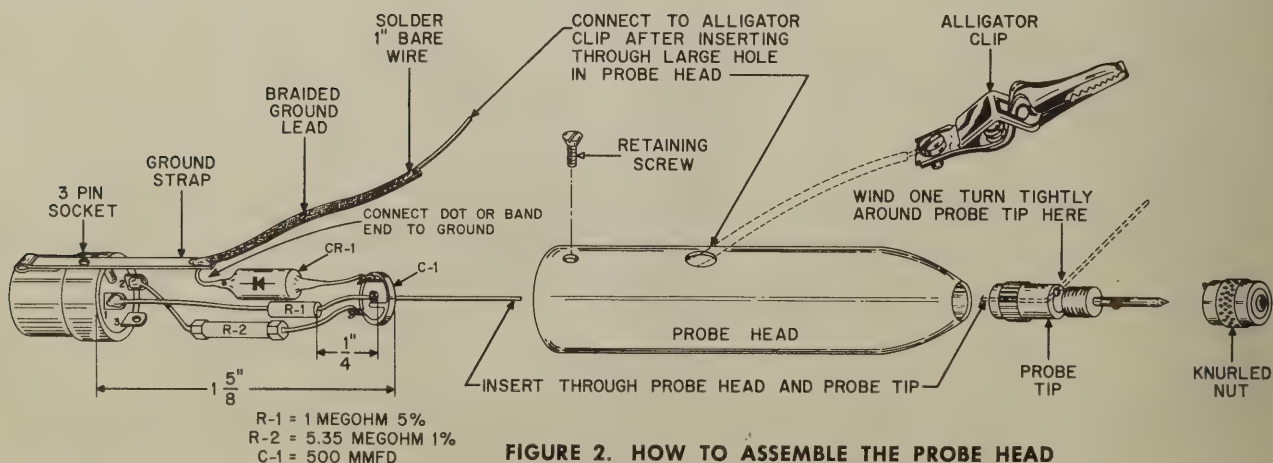
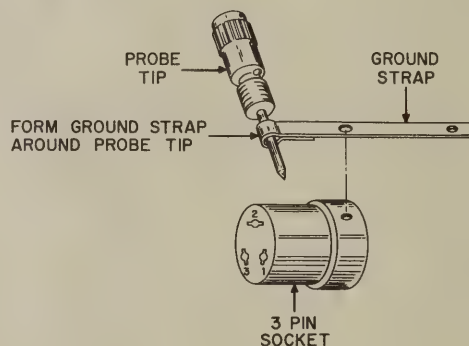
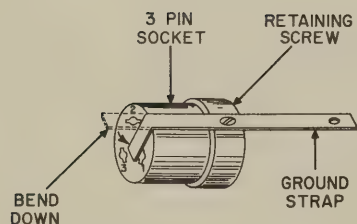


FIGURE 2. HOW TO ASSEMBLE THE PROBE HEAD

## THE KNIGHT RF PROBE

The KNIGHT RF Probe extends the working range of a VTVM to 250 megacycles. A multiple purpose head permits the probe to be used for both RF and DC measurements by merely rotating the head of the probe. The probe is shielded and the connecting cable is flexible and shielded.

When you unpack your probe kit, check all of the parts against the Parts List. Study the diagrams so you understand the assembly of the parts.

**USE ONLY ROSIN CORE SOLDER. KITS WIRED WITH ACID CORE SOLDER OR ACID FLUX WILL CORRODE AND WILL NOT WORK LONG. SUCH KITS ARE NOT ELIGIBLE FOR REPAIR OR SERVICE.**

You are ready to assemble your kit.

### SEE FIGURE 1.

- ☒ Attach the connector to one end of the cable as shown in Figure 1.
- ☒ Slide the cable and plug housing over the other end of the cable. Remove  $1\frac{1}{8}$ " of the outer insulation from the end of the cable. Unravel the shielded braid and fold it back over the cut off insulation. Wrap four turns of a 4" bare wire around the folded back braid. Lay the ground strap flat against the cable. Pass each end of the bare wire through the small hole in the end of the ground strap, and form a hook in each end to hold it in position. Coat the bare wire lightly with solder. Solder the ground strap securely to the bare wire. **DO NOT USE TOO MUCH HEAT** or the inner cable insulation will melt.
- ☒ Remove  $\frac{7}{8}$ " insulation from the inner conductor. Solder it securely to the 1-pin plug.
- ☒ Bend the ground strap back on itself so the other hole in it lines up with the hole in the 1-pin plug.
- ☒ Wrap the 4" length of tape (it is wound on the probe housing shield) around the cable as shown to provide strain relief.
- ☒ Slide the cable and plug housing down over the assembly. Tighten, one of the retaining screws into the small hole nearest the 1-pin plug. Bend the ground strap back over the housing.
- ☒ Insert the end of the probe housing shield (with the small hole in it) over the cable and plug housing. Slide the plastic cover back slightly. Tighten a retaining screw through the shield into the housing.

### SEE FIGURE 2.

- ☒ Form the ground strap as shown.
- ☒ Pass one lead of R-1, 1 megohm, 5% resistor, through C-1, the 500 MMFD button-type, feed-

through capacitor. **The body of R-1 MUST BE  $\frac{1}{4}$ " from the body of C-1.** Solder this lead to C-1. The spacing between the front of C-1 and the terminal side of the socket must be  $1\frac{5}{8}$ ". Solder the other lead to terminal 1 of the socket.

- ☒ Position R-2, 5.35 megohm, 1% precision resistor, as shown. Solder one lead to one of the terminals on the outer edge of C-1. Solder the other lead to terminal 2 of the 3-pin socket.
- ☒ Solder the unmarked end of CR-1, the crystal diode, to terminal 2 of C-1. Connect, but do not solder, the other lead to the ground strap.
- ☒ Solder a 1" bare wire to one end of the braided ground lead. The other end will be connected to the alligator clip later.
- ☒ Solder the other end of the braided ground lead to the ground strap as shown.
- ☒ Insert the assembly of the resistors, capacitor, and crystal diode into the probe head. Bring the ground lead out through the large hole, and fasten the bare wire under the screw of the alligator clip.
- ☒ Pass the bare wire coming through C-1 out the small hole in the probe tip. Insert the probe tip into the probe head. Wind one turn around the base of the tip. Tighten the knurled nut very securely.
- ☒ Secure the 3-pin socket in the probe head with the other retaining screw.
- ☒ Choose the function you desire and plug the probe head into the housing.

You have finished your KNIGHT RF Probe. Check all of the work. Be sure the dimensions are as shown in the figures.

## USING THE RF PROBE

The KNIGHT RF Probe may be used to measure RF voltages up to 25 volts rms in circuits where the DC voltage is as high as 300 volts. Read the voltages on the DC or rms scales. The RF voltage has been rectified and calibrated to correspond to a DC voltage which is proportional to the peak of the original RF voltage.

The frequency range is from 50 KC to 250 MC. The accuracy is  $\pm 10\%$  within the given frequency range.

The KNIGHT RF Probe uses a germanium diode, CR-1, to rectify the RF voltage or current to DC. C-1, the 500 MMFD capacitor, charges to a voltage approximately equal to the peak of the signal voltage being measured, and also prevents any DC in the circuit under test from getting into the probe. R-2, the 5.35 megohm, 1% precision resistor, serves two purposes: Calibration and RF isolation.

R-1, the 1 megohm resistor, is the isolation resistor, which replaces the isolation resistor in the DC test lead so that it is not necessary to change back and forth from the DC test lead to the RF Probe.

## ALLIED'S SERVICE FACILITIES

In the event that the kit does not operate properly, please write our Kit Department with full details and include the stock number and the date of purchase of the kit. We may be able to determine any wiring error or replace a component which may be at fault.

This wired KNIGHT kit may be returned for inspection within 1 year after purchase for a special service charge of \$1.00. Parts within the standard RETMA 90-day warranty period will be replaced without charge for the parts. An additional charge will be made for parts damaged in construction or because of a wiring error, or for parts which are beyond the 90-day warranty period. After the one-year period, service charges, plus cost of parts, are based on the length of time required to repair the unit.

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Allied's facilities primarily provide an inspection and trouble-shooting service. Kits not completed which require extensive work will be returned collect with a letter of explanation.

If you must return this kit, pack it well. Use the original packing carton with cushioning material around the probe. Send the kit prepaid and insured. We will return the repaired kit to you C.O.D. as soon as repairs are completed. If you wish to save C.O.D. fees, your advance remittance may be enclosed for standard repair charges plus transportation costs. Any excess remittance will be refunded.

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## PARTS LIST

SYMBOL NUMBER	DESCRIPTION	PART NO.
R-1	Resistor, 1 Megohm, $\frac{1}{2}$ watt, 5%.....	302105 ✓
R-2	Resistor, 5.35 Megohm, $\frac{1}{2}$ watt, 1%.....	345356 ✓
C-1	Capacitor, 500 MMFD, button-type feed-through ceramic .....	296003 ✓
CR-1	Diode, crystal, germanium, 705A or 1N34A only .....	630001 or 630002 ✓

QUANTITY	DESCRIPTION	PART NO.
48"	Cable, shielded, RG-58/U .....	803001 ✓
1 ea.	Clip, alligator .....	532005 ✓
1 ea.	Connector, cable .....	502224 ✓
1 ea.	Head, probe .....	870014 ✓
1 ea.	Housing, cable and plug .....	870016 ✓
1 ea.	Manual, instruction .....	750010 ✓
1 ea.	Plug, 1-pin .....	502130 ✓
3 ea.	Screw, retaining .....	563230 ✓
1 ea.	Shield, housing, with plastic cover.....	470052 ✓
2½"	Shielding, braid .....	804003 ✓
1 ea.	Socket, 3-pin .....	502230 ✓
7"	Solder, rosin-core .....	930007 ✓
2 ea.	Strap, ground .....	470048 ✓
4"	Tape, $\frac{1}{2}$ " .....	811001 ✓
1 ea.	Tip, probe .....	502118 ✓
5"	Wire, #20, bare .....	806005 ✓

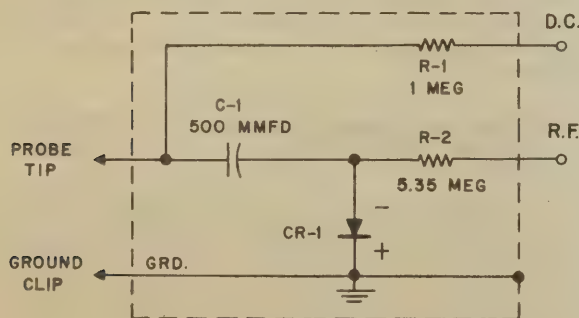


FIGURE 3. SCHEMATIC DIAGRAM,  
KNIGHT RF PROBE





























*Microcraft*

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SOLD BY	CASH	C O D	CHARGE	ON ACCT	MOSE RETD	PAID OUT
ck/7348						
QUAN.	DESCRIPTION	AMOUNT				
1	CSCAN: CODE SCANNER	179 00				
2	S&H	6 00				
3		185 00				
4						
5						
6						
Thank you for your order.						
We hope you enjoy using your						
CODE SCANNER.						

KEEP THIS SLIP FOR REFERENCE





















# The ARRL World Grid Locator Atlas

Containing all 32,400 Maidenhead Locator Squares

## Contents

The Maidenhead Locator System.....	2
Computer program for direction and distance.....	3
Longitude 180 W to 120 W and latitude 90 S to 30 S.....	4
Longitude 180 W to 120 W and latitude 30 S to 30 N.....	5
Longitude 180 W to 120 W and latitude 30 N to 90 N.....	6
Longitude 120 W to 60 W and latitude 90 S to 30 S.....	7
Longitude 120 W to 60 W and latitude 30 S to 30 N.....	8
Longitude 120 W to 60 W and latitude 30 N to 90 N.....	9
Longitude 60 W to 0 W and latitude 90 S to 30 S.....	10
Longitude 60 W to 0 W and latitude 30 S to 30 N.....	11
Longitude 60 W to 0 W and latitude 30 N to 90 N.....	12
Longitude 0 E to 60 E and latitude 90 S to 30 S.....	13
Longitude 0 E to 60 E and latitude 30 S to 30 N.....	14
Longitude 0 E to 60 E and latitude 30 N to 90 N.....	15
Longitude 60 E to 120 E and latitude 90 S to 30 S.....	16
Longitude 60 E to 120 E and latitude 30 S to 30 N.....	17
Longitude 60 E to 120 E and latitude 30 N to 90 N.....	18
Longitude 120 E to 180 E and latitude 90 S to 30 S.....	19
Longitude 120 E to 180 E and latitude 30 S to 30 N.....	20
Longitude 120 E to 180 E and latitude 30 N to 90 N.....	21
Index.....	22-24
Field Map and invitation to field competition.....	24



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Newington, CT 06111 U.S.A.

## The Maidenhead Locator System

### Background

In the 1950s there was a need among central European VHF and UHF amateurs for a short way of giving positions in contests, because the scoring was based on the distance, normally 1 point per kilometer, and the so called "QRA locator", name changed in 1972 to "QTH locator", was introduced. The system used 2 letters to indicate the largest unit, "square", that was 2 degrees (longitude) \* 1 degree (latitude). Without repetitions the system covered the area 0-52 degrees eastern longitude and 40-66 degrees northern latitude.

The system became very popular and amateurs started to use it in all types of contacts, not only in contests. It also spread outside the non-repeating area and the same locator could unfortunately be found in many places. North American radio amateurs also started to show interest in the locator idea.

For these and other reasons the author proposed at a meeting of European VHF managers in Amsterdam in 1976 that we should start discussing a worldwide locator system that could replace the old one. In 1978 Region 1 of the International Amateur Radio Union (IARU) decided to contact the other regions on this matter and the author started to collect proposals for a new system.

In October 1979 the author proposed a system starting at the principal dateline with 20 x 10 degrees large units, 2 x 1 degrees middle units and 6 x 3 minutes small units. Two months later the author received a letter from Dr. John Morris (G4ANB), who proposed a system starting at the Greenwich longitude with 20 x 10 degrees large units, 2 x 1 degrees middle units and 5 x 2.5 minutes small units without having seen the author's proposal. The systems were in all other respects identical.

In April 1980 a meeting of European VHF managers was held in Maidenhead, near London (United Kingdom), where it was felt that the time had come to try to find the best system out of the more than 20 proposals received so far. It was found that the best possible system was the system proposed by G4ANB, with the modification that the starting point should be shifted to the principal dateline, in accordance with what had been proposed by the author.

In 1982 the Maidenhead locator system was adopted by IARU Region 3, in 1983 the Maidenhead locator system was adopted by IARU Region 2 and in April 1984 the Maidenhead locator system was adopted by IARU Region 1 as new locator from 1985, January 1.

### World Atlas

Since the Maidenhead conference in 1980 the author had hoped that someone would produce a world map or a world atlas showing the new locator system, if possible down to the square level. In April 1984 when the system had been adopted by all three IARU regions, nothing had happened, and since there were no indications of anything happening, the author decided to try to do something himself. The result is this world atlas and it has been produced on a Dyeer Daisy DW16 printer with the geographical picture added afterwards by hand. Western longitudes and southern latitudes have been given a negative sign ( - ) and eastern longitudes and northern latitudes have been given a positive sign ( + ).

The oceans are full of banks, pinnacles, pyramids, reefs, rocks, shoals, etcetera and although it has been the intention only to include objects above the sea level, the author cannot guarantee that he has succeeded to 100 per cent. The principle for names of countries, islands, towns and other geographical objects has been to give the official name used in the majority language of the country, together with the English name, if it differs considerably, for example Magyarország (Hungary). If the difference is small, like Warszawa (Warsaw), the English name has not been included. In some cases the situation is complicated by the fact that a minority language might locally be a majority language. For example the island called "Rapa Nui" by its inhabitants is called "Isla De Pascua" by the central government and "Easter Island" in English. The author would prefer each geographical object to have the same name in all languages.

It is hoped that this world atlas could be of some use until something better has been produced. Anyone having comments or additional information is welcome to write to the address on page 24.

### Projection and Scale

The projection is rectangular on all maps with the longitude/latitude ratio 1/1 at 45 degrees latitude. This means that the geographical picture looks "too narrow" between the equator and 45 degrees latitude and "too wide" between 45 degrees latitude and the poles. In south-north direction the scale is 1/30000000 everywhere, and in west-east direction the scale is varying from 1/42000000 at the equator to 1/0 at the poles. This world atlas should generally not be used for distance measuring purposes.

### Description of the Maidenhead Locator System

The earth's surface is divided into 18 x 18 = 324 "fields", each one 20 degrees (longitude) x 10 degrees (latitude). Each field is divided into 10 x 10 = 100 "squares", each one 2 degrees (longitude) x 1 degree (latitude). Each square is finally divided into 24 x 24 = 576 "sub-squares", each one 5 minutes (longitude) x 2.5 minutes (latitude). The fields are indicated by 2 letters AA-RR, the squares by 2 digits 00-99 and the sub-squares by 2 letters AA-XX. The first character is the longitude character and the second character is the latitude character on each level. The numbering direction is everywhere west to east and south to north. The complete locator is the sum of all 6 characters, for example "FN43MJ". Recommended abbreviation for the word "locator" on CW is "LOC". A world map showing the 324 fields can be found on page 24 and maps showing the 32,400 squares can be found on pages 4-21.

### Finding One's Maidenhead Locator

Start by finding your longitude and latitude in degrees and minutes from a local map. Then read the first 4 characters (field + square) directly from a map on the pages 4-21. Then read the fifth and sixth characters (subsquare) from the tables below. Now you must be careful. Because a square is 2 degrees wide (west-east), you must observe if you are in the left part (western part) or in the right part (eastern part) of the longitude table. Please also observe that the upper parts of the tables are for eastern longitudes and northern latitudes and the lower parts of the tables are for western longitudes and southern latitudes. This is because the locator has a constant direction, while longitude and latitude are changing directions at the Greenwich longitude and at the equator. Do not forget to print your locator on your QSL card!

EASTERN LONGITUDE																									
EVEN DEGREES													ODD DEGREES												
+10'+20'+30'+40'+50'													+10'+20'+30'+40'+50'												
WEST	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	EAST
+50'+40'+30'+20'+10'													+50'+40'+30'+20'+10'												
ODD DEGREES													EVEN DEGREES												
WESTERN LONGITUDE																									

NORTHERN LATITUDE																									
SOUTH	+5'+10'+15'+20'+25'+30'+35'+40'+45'+50'+55'																								NORTH
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	
	+55'+50'+45'+40'+35'+30'+25'+20'+15'+10'+5'																								
SOUTHERN LATITUDE																									

### Computer Program for Locator Determination

This BASIC program converts longitude and latitude into locator. Input can be degrees, minutes and seconds or degrees and decimal minutes (seconds = 0) or decimal degrees (minutes and seconds = 0). Western longitudes and southern latitudes should be entered as negative values. Example: 80 degrees 21 minutes 30 seconds western longitude and 38 degrees 12 minutes 35 seconds northern latitude should be entered as -80, -21, -30 and 38, 12, 35 and the result should be EM98TF.

```
100 PRINT"DEGREES, MINUTES, SECONDS":E=1E-6
110 INPUT"LONGITUDE":A,B,C:A=A+B/60+C/3600+E:IFA<-180ORA>=180THEN110
120 INPUT"LATITUDE":B,C,D:B=B+C/60+D/3600+E:IFB<-90ORB>=90THEN120
130 A=A/20+9:B=B/10+9:C=INT(A):D=INT(B):A$=CHR$(C+65)+CHR$(D+65)
140 A=(A-C)*10:B=(B-D)*10:C=INT(A):D=INT(B)
150 A$=A$+CHR$(C+48)+CHR$(D+48)+CHR$(INT((A-C)*24)+65)+CHR$(INT((B-D)*24)+65)
160 PRINT"LOCATOR ";A$:GOTO100
```

## Computer Program for Direction and Distance

Most computer programs for distance calculation are based on the simple model of the earth being a sphere. When used worldwide the error might reach 70 km in some cases because of the ellipsoidal shape of the earth. When used locally (within 2000 km) the error might reach 10 km depending on direction and distance.

In 1883 Jordan published a formula based on the ellipsoidal shape of the earth. The Jordan formula works well over most of the earth's surface, but at very large distances the error might reach 100 km. The Jordan formula has been used by many radio amateurs for many years.

In the end of 1984 the author decided to try to write a computer program, that gives good results between any two points of the earth's surface, and the result is shown below. The maximum error for distances between midpoints of fields, squares or subsquares should be  $\pm 1$  km in the range 0 – 18000 km and  $\pm 2$  km in the range 18000-20004 km. Direction determination for very short distances and for very long distances (near the antipode) is numerically unstable and the error will rapidly increase when going to 0 or 20004 km. Also because of the ellipsoidal shape of the earth, direction determination near the antipode is complicated. But in the range 50-18000 km the maximum error for midpoints of fields, squares or subsquares should be  $\pm 1$  deg.

If any of the readers should have a program that gives still better results, the author would be interested to get a copy.

Input can be field or field + square or field + square + subsquare. Illegal character combinations will not be accepted. Direction and distance will be calculated from and to center of field, square or subsquare. At the equator the maximum error is for fields  $\pm 2500$  km, for squares  $\pm 250$  km and for subsquares  $\pm 10$  km. At 60 deg latitude the values are  $\pm 1500$  km,  $\pm 150$  km and  $\pm 6$  km.

## In Case of Trouble

In case this program should not work properly, you can compare your values line by line with the values below for the example EJ50CE to NJ40VE. (\*) means first time values in loop or subroutine. Please observe that minor differences do not have to be errors. The result of this example should be 48 deg and 19955 km.

Some versions of BASIC do not accept expressions like  $B\$ = MID\$(A\$,3,1)$ , which means take the third character from the string A\$. For example if  $A\$ = "COMPUTER"$ , it will give the result "M". If so you should consult your computer manual to make the necessary changes.

The program was written on a Commodore PET 2001-32 personal computer.

<pre> 100 X0=6378.140:X1=6356.755:X2=.014:X3=1.8:X4=4:X5=2*ATN(1):X6=2*X5:X7=2*X6 110 X8=X5/90:A=X0*X0:B=X1*X1:B1=(A-B)/B:C=SQR(B):A=A/X1:X9=(1+1/C/B)*A/2 120 Y0=A-X9:Y1=(X0+A)/2:Y2=A-Y1:Y3=(2*X9/X0-1)*X6:Y4=X0-X9:Y5=X7*(1-X9/X0) 130 Y5=Y5*Y5 140 INPUT"FROM LOC";A\$:GOSUB290:IFE=1THENE=0:GOTO140 150 A=C*X8:B=D*X8 160 INPUT"TO LOC";A\$:GOSUB290:IFE=1THENE=0:GOTO160 170 C=C*X8:D=D*X8:E=C-A:F=SIN(B):G=SIN(D):H=COS(B):I=COS(D):J=COS(E) 180 K=F*G+H*I:J:GOSUB370:M=L:IFABS(K)&lt;1THENN=(G*H-I*F*J)/SQR(1-K*K) 190 K=N:GOSUB370:G=L:I=M/X4:J=-1/2:P=0:FORQ=1TOX4:J=J+I:K=COS(J)*F+SIN(J)*H*M 200 GOSUB370:R=0:IFL&lt;&gt;0THENR=H*SIN(G)/SIN(L) 210 S=R*X5:IFABS(R)&lt;1THENS=ATN(R/SQR(1-R*R)) 220 R=COS(2*L):T=X9+Y0*R:R=Y1+Y2*R:P=P+(T+R)/2+(T-R)/2*COS(2*S):NEXT F=P/X4 230 H=0:I=M-Y3:IFI&gt;0THENH=I*(F-X9)/Y5 240 I=SIN(X6*(X0-F)/Y4):J=Y3*(1-X2*I) 250 IFM&gt;JTHENH=H+X3*I*SIN(X6*SQR((X6-M)/(X6-J))) 260 F=(F-H)*M:IFF&lt;.5ORF&gt;20003.5THENG=0:GOTO280 270 IFE*(X6-ABS(E))&lt;0THENG=X7-G 280 PRINTINT(G/X8+.5)"DEG. "INT(F+.5)"KM.":GOTO160 290 F=LEN(A\$):IFF&lt;&gt;2ANDF&lt;&gt;4ANDF&lt;&gt;6THENE=1:RETURN 300 FORG=1TOF:A(G)=ASC(MID\$(A\$,G,1)):NEXT 310 IFA(1)&lt;65ORA(1)&gt;82ORA(2)&lt;65ORA(2)&gt;82THENE=1:RETURN 320 C=A(1)*20-1480:D=A(2)*10-740:IFF=2THENC=C+10:D=D+.5:RETURN 330 IFA(3)&lt;48ORA(3)&gt;57ORA(4)&lt;48ORA(4)&gt;57THENE=1:RETURN 340 C=C+A(3)*2-96:D=D+A(4)-48:IFF=4THENC=C+1:D=D+.5:RETURN 350 IFA(5)&lt;65ORA(5)&gt;88ORA(6)&lt;65ORA(6)&gt;88THENE=1:RETURN 360 C=C+(A(5)-64.5)/12:D=D+(A(6)-64.5)/24:RETURN 370 IFK=1THENK=1:L=0:RETURN 380 IFK&lt;=-1THENK=-1:L=X6:RETURN 390 L=X5-ATN(K/SQR(1-K*K)):RETURN </pre>	<pre> X0=6378.14 X1=6356.755 X2=.014 X3=1.8 X4=4 X5=1.57079633 X6=3.14159266 X7=6.28318531 X8=.0174532925 A=40680669.9 B=40408334.1 B=1.00673959 C=1.00336414 A=6399.59694 X9=6367.51932 Y0=32.0776196 Y1=6388.86847 Y2=10.7284698 Y3=3.13113009 Y4=10.6206779 Y5=.0104625626 Y5=1.09465217E-04 A\$=EJ50CE E=0 A=-1.56716022 B=3.27249235E-03 A\$=NJ40VE E=0 C=1.56716022 D=3.27249235E-03 E=3.13432045 F=3.27248651E-03 G=3.27248651E-03 H=.999994645 I=.999994645 J=-.999973557 K=-.999952139 M=3.13180889 ABS(K)=.999952139 N=.668960718 X=.668960718 G=.837986625 I=.782952222 J=-.391476111 P=0 Q=1 J=.391476111(*) K=.258267694(*) R=0(*) L=1.3095677(*) R=.769396803(*) S=1.20856567(*) ABS(R)=.769396803(*) S=.877896305(*). R=-.866595596(*) T=6339.721(*) R=6379.57123(*) P=6363.3112(*) F=6373.43687 H=0 I=6.78794459E-04 H=.0249081979 I=.983912985 J=3.08799946 M=3.13180889 J=3.08799946 H=1.74991694 F=19954.9058 E*(X6-ABS(E))=.0227934247 INT(G/X8+.5)=48 INT(F+.5)=19955 F=6(*) A(1)=69(*) A(2)=74(*) A(3)=53(*) A(4)=48(*) A(5)=67(*) A(6)=69(*) (A1)=69(*) A(2)=74(*) C=-100(*) D=0(*) A(3)=53(*) A(4)=48(*) C=-90(*) D=0(*) A(5)=67(*) A(6)=69(*) C=-89.7916667(*) D=.1875(*) K=-.999952139(*) K=-.999952139(*) L=3.13180889(*) </pre>
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## SOME EXAMPLES

FK - DN GIVES 320 DEG AND 5011 KM. MN83 - AE16 GIVES 117 DEG AND 14245 KM. AA00AA - JRO9AX GIVES 0 DEG AND 20004 KM.







-180 -178 -176 -174 -172 -170 -168 -166 -164 -162 -160 -158 -156 -154 -152 -150 -148 -146 -144 -142 -140 -138 -136 -134 -132 -130 -128 -126 -124 -122 -120

+30	AL09	AL19	AL29	AL39	AL49	AL59	AL69	AL79	AL89	AL99	BL09	BL19	BL29	BL39	BL49	BL59	BL69	BL79	BL89	BL99	CL09	CL19	CL29	CL39	CL49	CL59	CL69	CL79	CL89	CL99	+30
+29	AL08	AL18	AL28	AL38	AL48	AL58	AL68	AL78	AL88	AL98	BL08	BL18	BL28	BL38	BL48	BL58	BL68	BL78	BL88	BL98	CL08	CL18	CL28	CL38	CL48	CL58	CL68	CL78	CL88	CL98	+29
+28	AL07	AL17	AL27	AL37	AL47	AL57	AL67	AL77	AL87	AL97	BL07	BL17	BL27	BL37	BL47	BL57	BL67	BL77	BL87	BL97	CL07	CL17	CL27	CL37	CL47	CL57	CL67	CL77	CL87	CL97	+28
+27	AL06	AL16	AL26	AL36	AL46	AL56	AL66	AL76	AL86	AL96	BL06	BL16	BL26	BL36	BL46	BL56	BL66	BL76	BL86	BL96	CL06	CL16	CL26	CL36	CL46	CL56	CL66	CL76	CL86	CL96	+27
+26	AL05	AL15	AL25	AL35	AL45	AL55	AL65	AL75	AL85	AL95	BL05	BL15	BL25	BL35	BL45	BL55	BL65	BL75	BL85	BL95	CL05	CL15	CL25	CL35	CL45	CL55	CL65	CL75	CL85	CL95	+26
+25	AL04	AL14	AL24	AL34	AL44	AL54	AL64	AL74	AL84	AL94	BL04	BL14	BL24	BL34	BL44	BL54	BL64	BL74	BL84	BL94	CL04	CL14	CL24	CL34	CL44	CL54	CL64	CL74	CL84	CL94	+25
+24	AL03	AL13	AL23	AL33	AL43	AL53	AL63	AL73	AL83	AL93	BL03	BL13	BL23	BL33	BL43	BL53	BL63	BL73	BL83	BL93	CL03	CL13	CL23	CL33	CL43	CL53	CL63	CL73	CL83	CL93	+24
+23	AL02	AL12	AL22	AL32	AL42	AL52	AL62	AL72	AL82	AL92	BL02	BL12	BL22	BL32	BL42	BL52	BL62	BL72	BL82	BL92	CL02	CL12	CL22	CL32	CL42	CL52	CL62	CL72	CL82	CL92	+23
+22	AL01	AL11	AL21	AL31	AL41	AL51	AL61	AL71	AL81	AL91	BL01	BL11	BL21	BL31	BL41	BL51	BL61	BL71	BL81	BL91	CL01	CL11	CL21	CL31	CL41	CL51	CL61	CL71	CL81	CL91	+22
+21	AL00	AL10	AL20	AL30	AL40	AL50	AL60	AL70	AL80	AL90	BL00	BL10	BL20	BL30	BL40	BL50	BL60	BL70	BL80	BL90	CL00	CL10	CL20	CL30	CL40	CL50	CL60	CL70	CL80	CL90	+21
+20	AK09	AK19	AK29	AK39	AK49	AK59	AK69	AK79	AK89	AK99	BK09	BK19	BK29	BK39	BK49	BK59	BK69	BK79	BK89	BK99	CK09	CK19	CK29	CK39	CK49	CK59	CK69	CK79	CK89	CK99	+20
+19	AK08	AK18	AK28	AK38	AK48	AK58	AK68	AK78	AK88	AK98	BK08	BK18	BK28	BK38	BK48	BK58	BK68	BK78	BK88	BK98	CK08	CK18	CK28	CK38	CK48	CK58	CK68	CK78	CK88	CK98	+19
+18	AK07	AK17	AK27	AK37	AK47	AK57	AK67	AK77	AK87	AK97	BK07	BK17	BK27	BK37	BK47	BK57	BK67	BK77	BK87	BK97	CK07	CK17	CK27	CK37	CK47	CK57	CK67	CK77	CK87	CK97	+18
+17	AK06	AK16	AK26	AK36	AK46	AK56	AK66	AK76	AK86	AK96	BK06	BK16	BK26	BK36	BK46	BK56	BK66	BK76	BK86	BK96	CK06	CK16	CK26	CK36	CK46	CK56	CK66	CK76	CK86	CK96	+17
+16	AK05	AK15	AK25	AK35	AK45	AK55	AK65	AK75	AK85	AK95	BK05	BK15	BK25	BK35	BK45	BK55	BK65	BK75	BK85	BK95	CK05	CK15	CK25	CK35	CK45	CK55	CK65	CK75	CK85	CK95	+16
+15	AK04	AK14	AK24	AK34	AK44	AK54	AK64	AK74	AK84	AK94	BK04	BK14	BK24	BK34	BK44	BK54	AK64	BK74	BK84	BK94	CK04	CK14	CK24	CK34	CK44	CK54	CK64	CK74	CK84	CK94	+15
+14	AK03	AK13	AK23	AK33	AK43	AK53	AK63	AK73	AK83	AK93	BK03	BK13	BK23	BK33	BK43	BK53	BK63	BK73	BK83	BK93	CK03	CK13	CK23	CK33	CK43	CK53	CK63	CK73	CK83	CK93	+14
+13	AK02	AK12	AK22	AK32	AK42	AK52	AK62	AK72	AK82	AK92	BK02	BK12	BK22	BK32	BK42	BK52	BK62	BK72	BK82	BK92	CK02	CK12	CK22	CK32	CK42	CK52	CK62	CK72	CK82	CK92	+13
+12	AK01	AK11	AK21	AK31	AK41	AK51	AK61	AK71	AK81	AK91	BK01	BK11	BK21	BK31	BK41	BK51	BK61	BK71	BK81	BK91	CK01	CK11	CK21	CK31	CK41	CK51	CK61	CK71	CK81	CK91	+12
+11	AK00	AK10	AK20	AK30	AK40	AK50	AK60	AK70	AK80	AK90	BK00	BK10	BK20	BK30	BK40	BK50	BK60	BK70	BK80	BK90	CK00	CK10	CK20	CK30	CK40	CK50	CK60	CK70	CK80	CK90	+11
+10	AJ09	AJ19	AJ29	AJ39	AJ49	AJ59	AJ69	AJ79	AJ89	AJ99	BJ09	BJ19	BJ29	BJ39	BJ49	BJ59	BJ69	BJ79	BJ89	BJ99	CJ09	CJ19	CJ29	CJ39	CJ49	CJ59	CJ69	CJ79	CJ89	CJ99	+10
+9	AJ08	AJ18	AJ28	AJ38	AJ48	AJ58	AJ68	AJ78	AJ88	AJ98	BJ08	BJ18	BJ28	BJ38	BJ48	BJ58	BJ68	BJ78	BJ88	BJ98	CJ08	CJ18	CJ28	CJ38	CJ48	CJ58	CJ68	CJ78	CJ88	CJ98	+9
+8	AJ07	AJ17	AJ27	AJ37	AJ47	AJ57	AJ67	AJ77	AJ87	AJ97	BJ07	BJ17	BJ27	BJ37	BJ47	BJ57	BJ67	BJ77	BJ87	BJ97	CJ07	CJ17	CJ27	CJ37	CJ47	CJ57	CJ67	CJ77	CJ87	CJ97	+8
+7	AJ06	AJ16	AJ26	AJ36	AJ46	AJ56	AJ66	AJ76	AJ86	AJ96	BJ06	BJ16	BJ26	BJ36	BJ46	BJ56	BJ66	BJ76	BJ86	BJ96	CJ06	CJ16	CJ26	CJ36	CJ46	CJ56	CJ66	CJ76	CJ86	CJ96	+7
+6	AJ05	AJ15	AJ25	AJ35	AJ45	AJ55	AJ65	AJ75	AJ85	AJ95	BJ05	BJ15	BJ25	BJ35	BJ45	BJ55	BJ65	BJ75	BJ85	BJ95	CJ05	CJ15	CJ25	CJ35	CJ45	CJ55	CJ65	CJ75	CJ85	CJ95	+6
+5	AJ04	AJ14	AJ24	AJ34	AJ44	AJ54	AJ64	AJ74	AJ84	AJ94	BJ04	BJ14	BJ24	BJ34	BJ44	BJ54	BJ64	BJ74	BJ84	BJ94	CJ04	CJ14	CJ24	CJ34	CJ44	CJ54	CJ64	CJ74	CJ84	CJ94	+5
+4	AJ03	AJ13	AJ23	AJ33	AJ43	AJ53	AJ63	AJ73	AJ83	AJ93	BJ03	BJ13	BJ23	BJ33	BJ43	BJ53	BJ63	BJ73	BJ83	BJ93	CJ03	CJ13	CJ23	CJ33	CJ43	CJ53	CJ63	CJ73	CJ83	CJ93	+4
+3	AJ02	AJ12	AJ22	AJ32	AJ42	AJ52	AJ62	AJ72	AJ82	AJ92	BJ02	BJ12	BJ22	BJ32	BJ42	BJ52	BJ62	BJ72	BJ82	BJ92	CJ02	CJ12	CJ22	CJ32	CJ42	CJ52	CJ62	CJ72	CJ82	CJ92	+3
+2	AJ01	AJ11	AJ21	AJ31	AJ41	AJ51	AJ61	AJ71	AJ81	AJ91	BJ01	BJ11	BJ21	BJ31	BJ41	BJ51	BJ61	BJ71	BJ81	BJ91	CJ01	CJ11	CJ21	CJ31	CJ41	CJ51	CJ61	CJ71	CJ81	CJ91	+2
+1	AJ00	AJ10	AJ20	AJ30	AJ40	AJ50	AJ60	AJ70	AJ80	AJ90	BJ00	BJ10	BJ20	BJ30	BJ40	BJ50	BJ60	BJ70	BJ80	BJ90	CJ00	CJ10	CJ20	CJ30	CJ40	CJ50	CJ60	CJ70	CJ80	CJ90	+1
0	AI09	AI19	AI29	AI39	AI49	AI59	AI69	AI79	AI89	AI99	BI09	BI19	BI29	BI39	BI49	BI59	BI69	BI79	BI89	BI99	CI09	CI19	CI29	CI39	CI49	CI59	CI69	CI79	CI89	CI99	0
-1	AI08	AI18	AI28	AI38	AI48	AI58	AI68	AI78	AI88	AI98	BI08	BI18	BI28	BI38	BI48	BI58	BI68	BI78	BI88	BI98	CI08	CI18	CI28	CI38	CI48	CI58	CI68	CI78	CI88	CI98	-1
-2	AI07	AI17	AI27	AI37	AI47	AI57	AI67	AI77	AI87	AI97	BI07	BI17	BI27	BI37	BI47	BI57	BI67	BI77	BI87	BI97	CI07	CI17	CI27	CI37	CI47	CI57	CI67	CI77	CI87	CI97	-2
-3	AI06	AI16	AI26	AI36	AI46	AI56	AI66	AI76	AI86	AI96	BI06	BI16	BI26	BI36	BI46	BI56	BI66	BI76	BI86	BI96	CI06	CI16	CI26	CI36	CI46	CI56	CI66	CI76	CI86	CI96	-3
-4	AI05	AI15	AI25	AI35	AI45	AI55	AI65	AI75	AI85	AI95	BI05	BI15	BI25	BI35	BI45	BI55	BI65	BI75	BI85	BI95	CI05	CI15	CI25	CI35	CI45	CI55	CI65	CI75	CI85	CI95	-4
-5	AI04	AI14	AI24	AI34	AI44	AI54	AI64	AI74	AI84	AI94	BI04	BI14	BI24	BI34	BI44	BI54	BI64	BI74	BI84	BI94	CI04	CI14	CI24	CI34	CI44	CI54	CI64	CI74	CI84	CI94	-5
-6	AI03	AI13	AI23	AI33	AI43	AI53	AI63	AI73	AI83	AI93	BI03	BI13	BI23	BI33	BI43	BI53	BI63	BI73	BI83	BI93	CI03	CI13	CI23	CI33	CI43	CI53	CI63	CI73	CI83	CI93	-6
-7	AI02	AI12	AI22	AI32	AI42	AI52	AI62	AI72	AI82	AI92	BI02	BI12	BI22	BI32	BI42	BI52	BI62	BI72	BI82	BI92	CI02	CI12	CI22	CI32	CI42	CI52	CI62	CI72	CI82	CI92	-7
-8	AI01	AI11	AI21	AI31	AI41	AI51	AI61	AI71	AI81	AI91	BI01	BI11	BI21	BI31	BI41	BI51	BI61	BI71	BI81	BI91	CI01	CI11	CI21	CI31	CI41	CI51	CI61	CI71	CI81	CI91	-8
-9	AI00	AI10	AI20	AI30	AI40	AI50	AI60	AI70	AI80	AI90	BI00	BI10	BI20	BI30	BI40	BI50	BI60	BI70	BI80	BI90	CI00	CI10	CI20	CI30	CI40	CI50	CI60	CI70	CI80	CI90	-9
-10	AH09	AH19	AH29	AH39	AH49	AH59	AH69	AH79	AH89	AH99	BH09	BH19	BH29	BH39	BH49	BH59	BH69	BH79	BH89	BH99	CH09	CH19	CH29	CH39	CH49	CH59	CH69	CH79	CH89	CH99	-10
-11	AH08	AH18	AH28	AH38	AH48	AH58	AH68	AH78	AH88	AH98	BH08	BH18	BH28	BH38	BH48	BH58	BH68	BH78	BH88	BH98	CH08	CH18	CH28	CH38	CH48	CH58	CH68	CH78	CH88	CH98	-11
-12	AH07	AH17	AH27	AH37	AH47	AH57	AH67	AH77	AH87	AH97	BH07	BH17	BH27	BH37	BH47	BH57	BH67	BH77	BH87	BH97	CH07	CH17	CH27	CH37	CH47	CH57	CH67	CH77	CH87	CH97	-12
-13	AH06	AH16	AH26	AH36	AH46	AH56	AH66	AH76	AH86	AH96	BH06	BH16	BH26	BH36	BH46	BH56	BH66	BH76	BH86	BH96	CH06	CH16	CH26	CH36	CH46	CH56	CH66	CH76	CH86	CH96	-13
-14	AH05	AH15	AH25	AH35	AH45	AH55	AH65	AH75	AH85	AH95	BH05	BH15	BH25	BH35	BH45	BH55	BH65	BH75	BH85	BH95	CH05	CH15	CH25	CH35	CH45	CH55	CH65	CH75	CH85	CH95	-14
-15	AH04	AH14	AH24	AH34	AH44	AH54	AH64	AH74	AH84	AH94	BH04	BH14	BH24	BH34	BH44	BH54	BH64	BH74	BH84	BH94	CH04	CH14	CH24	CH34	CH44	CH54	CH64	CH74	CH84	CH94	-15
-16	AH03	AH13	AH23	AH33	AH43	AH53	AH63	AH73	AH83	AH93	BH03	BH13	BH23	BH33	BH43	BH53	BH63	BH73	BH83	BH93	CH03	CH13	CH23	CH33	CH43	CH53	CH63	CH73	CH83	CH93	-16
-17	AH02	AH12	AH22	AH32	AH42	AH52	AH62	AH72	AH82	AH92	BH02	BH12	BH22	BH3																	



	-180 -178 -176 -174 -172 -170 -168 -166 -164 -162 -160 -158 -156 -154 -152 -150 -148 -146 -144 -142 -140 -138 -136 -134 -132 -130 -128 -126 -124 -122 -120																																						
90	AR09	AR19	AR29	AR39	AR49	AR59	AR69	AR79	AR89	AR99	BR09	BR19	BR29	BR39	BR49	BR59	BR69	BR79	BR89	BR99	CR09	CR19	CR29	CR39	CR49	CR59	CR69	CR79	CR89	CR99									
89	AR08	AR18	AR28	AR38	AR48	AR58	AR68	AR78	AR88	AR98	BR08	BR18	BR28	BR38	BR48	BR58	BR68	BR78	BR88	BR98	CR08	CR18	CR28	CR38	CR48	CR58	CR68	CR78	CR88	CR98									
88	AR07	AR17	AR27	AR37	AR47	AR57	AR67	AR77	AR87	AR97	BR07	BR17	BR27	BR37	BR47	BR57	BR67	BR77	BR87	BR97	CR07	CR17	CR27	CR37	CR47	CR57	CR67	CR77	CR87	CR97									
87	AR06	AR16	AR26	AR36	AR46	AR56	AR66	AR76	AR86	AR96	BR06	BR16	BR26	BR36	BR46	BR56	BR66	BR76	BR86	BR96	CR06	CR16	CR26	CR36	CR46	CR56	CR66	CR76	CR86	CR96									
86	AR05	AR15	AR25	AR35	AR45	AR55	AR65	AR75	AR85	AR95	BR05	BR15	BR25	BR35	BR45	BR55	BR65	BR75	BR85	BR95	CR05	CR15	CR25	CR35	CR45	CR55	CR65	CR75	CR85	CR95									
85	AR04	AR14	AR24	AR34	AR44	AR54	AR64	AR74	AR84	AR94	BR04	BR14	BR24	BR34	BR44	BR54	BR64	BR74	BR84	BR94	CR04	CR14	CR24	CR34	CR44	CR54	CR64	CR74	CR84	CR94									
84	AR03	AR13	AR23	AR33	AR43	AR53	AR63	AR73	AR83	AR93	BR03	BR13	BR23	BR33	BR43	BR53	BR63	BR73	BR83	BR93	CR03	CR13	CR23	CR33	CR43	CR53	CR63	CR73	CR83	CR93									
83	AR02	AR12	AR22	AR32	AR42	AR52	AR62	AR72	AR82	AR92	BR02	BR12	BR22	BR32	BR42	BR52	BR62	BR72	BR82	BR92	CR02	CR12	CR22	CR32	CR42	CR52	CR62	CR72	CR82	CR92									
82	AR01	AR11	AR21	AR31	AR41	AR51	AR61	AR71	AR81	AR91	BR01	BR11	BR21	BR31	BR41	BR51	BR61	BR71	BR81	BR91	CR01	CR11	CR21	CR31	CR41	CR51	CR61	CR71	CR81	CR91									
81	AR00	AR10	AR20	AR30	AR40	AR50	AR60	AR70	AR80	AR90	BR00	BR10	BR20	BR30	BR40	BR50	BR60	BR70	BR80	BR90	CR00	CR10	CR20	CR30	CR40	CR50	CR60	CR70	CR80	CR90									
80	AQ09	AQ19	AQ29	AQ39	AQ49	AQ59	AQ69	AQ79	AQ89	AQ99	BQ09	BQ19	BQ29	BQ39	BQ49	BQ59	BQ69	BQ79	BQ89	BQ99	CQ09	CQ19	CQ29	CQ39	CQ49	CQ59	CQ69	CQ79	CQ89	CQ99									
79	AQ08	AQ18	AQ28	AQ38	AQ48	AQ58	AQ68	AQ78	AQ88	AQ98	BQ08	BQ18	BQ28	BQ38	BQ48	BQ58	BQ68	BQ78	BQ88	BQ98	CQ08	CQ18	CQ28	CQ38	CQ48	CQ58	CQ68	CQ78	CQ88	CQ98									
78	AQ07	AQ17	AQ27	AQ37	AQ47	AQ57	AQ67	AQ77	AQ87	AQ97	BQ07	BQ17	BQ27	BQ37	BQ47	BQ57	BQ67	BQ77	BQ87	BQ97	CQ07	CQ17	CQ27	CQ37	CQ47	CQ57	CQ67	CQ77	CQ87	CQ97									
77	AQ06	AQ16	AQ26	AQ36	AQ46	AQ56	AQ66	AQ76	AQ86	AQ96	BQ06	BQ16	BQ26	BQ36	BQ46	BQ56	BQ66	BQ76	BQ86	BQ96	CQ06	CQ16	CQ26	CQ36	CQ46	CQ56	CQ66	CQ76	CQ86	CQ96									
76	AQ05	AQ15	AQ25	AQ35	AQ45	AQ55	AQ65	AQ75	AQ85	AQ95	BQ05	BQ15	BQ25	BQ35	BQ45	BQ55	BQ65	BQ75	BQ85	BQ95	CQ05	CQ15	CQ25	CQ35	CQ45	CQ55	CQ65	CQ75	CQ85	CQ95									
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74	AQ03	AQ13	AQ23	AQ33	AQ43	AQ53	AQ63	AQ73	AQ83	AQ93	BQ03	BQ13	BQ23	BQ33	BQ43	BQ53	BQ63	BQ73	BQ83	BQ93	CQ03	CQ13	CQ23	CQ33	CQ43	CQ53	CQ63	CQ73	CQ83	CQ93									
73	AQ02	AQ12	AQ22	AQ32	AQ42	AQ52	AQ62	AQ72	AQ82	AQ92	BQ02	BQ12	BQ22	BQ32	BQ42	BQ52	BQ62	BQ72	BQ82	BQ92	CQ02	CQ12	CQ22	CQ32	CQ42	CQ52	CQ62	CQ72	CQ82	CQ92									
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67	AP06	AP16	AP26	AP36	AP46	AP56	AP66	AP76	AP86	AP96	BP06	BP16	BP26	BP36	BP46	BP56	BP66	BP76	BP86	BP96	CP06	CP16	CP26	CP36	CP46	CP56	CP66	CP76	CP86	CP96									
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49	AN08	AN18	AN28	AN38	AN48	AN58	AN68	AN78	AN88	AN98	BN08	BN18	BN28	BN38	BN48	BN58																							



	-120	-118	-116	-114	-112	-110	-108	-106	-104	-102	-100	-98	-96	-94	-92	-90	-88	-86	-84	-82	-80	-78	-76	-74	-72	-70	-68	-66	-64	-62	-60	
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-35	DF04	DF14	DF24	DF34	DF44	DF54	DF64	DF74	DF84	DF94	EF04	EF14	EF24	EF34	EF44	EF54	EF64	EF74	EF84	EF94	FF04	FF14	FF24	FF34	FF44	FF54	FF64	FF74	FF84	FF94		-35
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-42	DE07	DE17	DE27	DE37	DE47	DE57	DE67	DE77	DE87	DE97	EO07	EO17	EO27	EO37	EO47	EO57	EO67	EO77	EO87	EO97	FO07	FO17	FO27	FO37	FO47	FO57	FO67	FO77	FO87	FO97		-42
-43	DE06	DE16	DE26	DE36	DE46	DE56	DE66	DE76	DE86	DE96	EO06	EO16	EO26	EO36	EO46	EO56	EO66	EO76	EO86	EO96	FO06	FO16	FO26	FO36	FO46	FO56	FO66	FO76	FO86	FO96		-43
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-47	DE02	DE12	DE22	DE32	DE42	DE52	DE62	DE72	DE82	DE92	EO02	EO12	EO22	EO32	EO42	EO52	EO62	EO72	EO82	EO92	FO02	FO12	FO22	FO32	FO42	FO52	FO62	FO72	FO82	FO92		-47
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-49	DE00	DE10	DE20	DE30	DE40	DE50	DE60	DE70	DE80	DE90	EO00	EO10	EO20	EO30	EO40	EO50	EO60	EO70	EO80	EO90	FO00	FO10	FO20	FO30	FO40	FO50	FO60	FO70	FO80	FO90		-49
-50	DD09	DD19	DD29	DD39	DD49	DD59	DD69	DD79	DD89	DD99	ED09	ED19	ED29	ED39	ED49	ED59	ED69	ED79	ED89	ED99	FD09	FD19	FD29	FD39	FD49	FD59	FD69	FD79	FD89	FD99		-50
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-55	DD04	DD14	DD24	DD34	DD44	DD54	DD64	DD74	DD84	DD94	ED04	ED14	ED24	ED34	ED44	ED54	ED64	ED74	ED84	ED94	FD04	FD14	FD24	FD34	FD44	FD54	FD64	FD74	FD84	FD94		-55
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-76	DB03																															



	-120	-118	-116	-114	-112	-110	-108	-106	-104	-102	-100	-98	-96	-94	-92	-90	-88	-86	-84	-82	-80	-78	-76	-74	-72	-70	-68	-66	-64	-62	-60	
+30	DL09	DL19	DL29	DL39	DL49	DL59	DL69	DL79	DL89	DL99	EL09	EL19	EL29	EL39	EL49	EL59	EL69	EL79	EL89	EL99	FL09	FL19	FL29	FL39	FL49	FL59	FL69	FL79	FL89	FL99	+30	
+29	DL08	DL18	DL28	DL38	DL48	DL58	DL68	DL78	DL88	DL98	EL08	EL18	EL28	EL38	EL48	EL58	EL68	EL78	EL88	EL98	FL08	FL18	FL28	FL38	FL48	FL58	FL68	FL78	FL88	FL98	+29	
+28	DL07	DL17	DL27	DL37	DL47	DL57	DL67	DL77	DL87	DL97	EL07	EL17	EL27	EL37	EL47	EL57	EL67	EL77	EL87	EL97	FL07	FL17	FL27	FL37	FL47	FL57	FL67	FL77	FL87	FL97	+28	
+27	DL06	DL16	DL26	DL36	DL46	DL56	DL66	DL76	DL86	DL96	EL06	EL16	EL26	EL36	EL46	EL56	EL66	EL76	EL86	EL96	FL06	FL16	FL26	FL36	FL46	FL56	FL66	FL76	FL86	FL96	+27	
+26	DL05	DL15	DL25	DL35	DL45	DL55	DL65	DL75	DL85	DL95	EL05	EL15	EL25	EL35	EL45	EL55	EL65	EL75	EL85	EL95	FL05	FL15	FL25	FL35	FL45	FL55	FL65	FL75	FL85	FL95	+26	
+25	DL04	DL14	DL24	DL34	DL44	DL54	DL64	DL74	DL84	DL94	EL04	EL14	EL24	EL34	EL44	EL54	EL64	EL74	EL84	EL94	FL04	FL14	FL24	FL34	FL44	FL54	FL64	FL74	FL84	FL94	+25	
+24	DL03	DL13	DL23	DL33	DL43	DL53	DL63	DL73	DL83	DL93	EL03	EL13	EL23	EL33	EL43	EL53	EL63	EL73	EL83	EL93	FL03	FL13	FL23	FL33	FL43	FL53	FL63	FL73	FL83	FL93	+24	
+23	DL02	DL12	DL22	DL32	DL42	DL52	DL62	DL72	DL82	DL92	EL02	EL12	EL22	EL32	EL42	EL52	EL62	EL72	EL82	EL92	FL02	FL12	FL22	FL32	FL42	FL52	FL62	FL72	FL82	FL92	+23	
+22	DL01	DL11	DL21	DL31	DL41	DL51	DL61	DL71	DL81	DL91	EL01	EL11	EL21	EL31	EL41	EL51	EL61	EL71	EL81	EL91	FL01	FL11	FL21	FL31	FL41	FL51	FL61	FL71	FL81	FL91	+22	
+21	DL00	DL10	DL20	DL30	DL40	DL50	DL60	DL70	DL80	DL90	EL00	EL10	EL20	EL30	EL40	EL50	EL60	EL70	EL80	EL90	FL00	FL10	FL20	FL30	FL40	FL50	FL60	FL70	FL80	FL90	+21	
+20	DK09	DK19	DK29	DK39	DK49	DK59	DK69	DK79	DK89	DK99	EL09	EL19	EL29	EL39	EL49	EL59	EL69	EL79	EL89	EL99	FK09	FK19	FK29	FK39	FK49	FK59	FK69	FK79	FK89	FK99	+20	
+19	DK08	DK18	DK28	DK38	DK48	DK58	DK68	DK78	DK88	DK98	EL08	EL18	EL28	EL38	EL48	EL58	EL68	EL78	EL88	EL98	FK08	FK18	FK28	FK38	FK48	FK58	FK68	FK78	FK88	FK98	+19	
+18	DK07	DK17	DK27	DK37	DK47	DK57	DK67	DK77	DK87	DK97	EL07	EL17	EL27	EL37	EL47	EL57	EL67	EL77	EL87	EL97	FK07	FK17	FK27	FK37	FK47	FK57	FK67	FK77	FK87	FK97	+18	
+17	DK06	DK16	DK26	DK36	DK46	DK56	DK66	DK76	DK86	DK96	EL06	EL16	EL26	EL36	EL46	EL56	EL66	EL76	EL86	EL96	FK06	FK16	FK26	FK36	FK46	FK56	FK66	FK76	FK86	FK96	+17	
+16	DK05	DK15	DK25	DK35	DK45	DK55	DK65	DK75	DK85	DK95	EL05	EL15	EL25	EL35	EL45	EL55	EL65	EL75	EL85	EL95	FK05	FK15	FK25	FK35	FK45	FK55	FK65	FK75	FK85	FK95	+16	
+15	DK04	DK14	DK24	DK34	DK44	DK54	DK64	DK74	DK84	DK94	EL04	EL14	EL24	EL34	EL44	EL54	EL64	EL74	EL84	EL94	FK04	FK14	FK24	FK34	FK44	FK54	FK64	FK74	FK84	FK94	+15	
+14	DK03	DK13	DK23	DK33	DK43	DK53	DK63	DK73	DK83	DK93	EL03	EL13	EL23	EL33	EL43	EL53	EL63	EL73	EL83	EL93	FK03	FK13	FK23	FK33	FK43	FK53	FK63	FK73	FK83	FK93	+14	
+13	DK02	DK12	DK22	DK32	DK42	DK52	DK62	DK72	DK82	DK92	EL02	EL12	EL22	EL32	EL42	EL52	EL62	EL72	EL82	EL92	FK02	FK12	FK22	FK32	FK42	FK52	FK62	FK72	FK82	FK92	+13	
+12	DK01	DK11	DK21	DK31	DK41	DK51	DK61	DK71	DK81	DK91	EL01	EL11	EL21	EL31	EL41	EL51	EL61	EL71	EL81	EL91	FK01	FK11	FK21	FK31	FK41	FK51	FK61	FK71	FK81	FK91	+12	
+11	DK00	DK10	DK20	DK30	DK40	DK50	DK60	DK70	DK80	DK90	EL00	EL10	EL20	EL30	EL40	EL50	EL60	EL70	EL80	EL90	FK00	FK10	FK20	FK30	FK40	FK50	FK60	FK70	FK80	FK90	+11	
+10	DJ09	DJ19	DJ29	DJ39	DJ49	DJ59	DJ69	DJ79	DJ89	DJ99	EL09	EL19	EL29	EL39	EL49	EL59	EL69	EL79	EL89	EL99	FK09	FK19	FK29	FK39	FK49	FK59	FK69	FK79	FK89	FK99	+10	
+9	DJ08	DJ18	DJ28	DJ38	DJ48	DJ58	DJ68	DJ78	DJ88	DJ98	EL08	EL18	EL28	EL38	EL48	EL58	EL68	EL78	EL88	EL98	FK08	FK18	FK28	FK38	FK48	FK58	FK68	FK78	FK88	FK98	+9	
+8	DJ07	DJ17	DJ27	DJ37	DJ47	DJ57	DJ67	DJ77	DJ87	DJ97	EL07	EL17	EL27	EL37	EL47	EL57	EL67	EL77	EL87	EL97	FK07	FK17	FK27	FK37	FK47	FK57	FK67	FK77	FK87	FK97	+8	
+7	DJ06	DJ16	DJ26	DJ36	DJ46	DJ56	DJ66	DJ76	DJ86	DJ96	EL06	EL16	EL26	EL36	EL46	EL56	EL66	EL76	EL86	EL96	FK06	FK16	FK26	FK36	FK46	FK56	FK66	FK76	FK86	FK96	+7	
+6	DJ05	DJ15	DJ25	DJ35	DJ45	DJ55	DJ65	DJ75	DJ85	DJ95	EL05	EL15	EL25	EL35	EL45	EL55	EL65	EL75	EL85	EL95	FK05	FK15	FK25	FK35	FK45	FK55	FK65	FK75	FK85	FK95	+6	
+5	DJ04	DJ14	DJ24	DJ34	DJ44	DJ54	DJ64	DJ74	DJ84	DJ94	EL04	EL14	EL24	EL34	EL44	EL54	EL64	EL74	EL84	EL94	FK04	FK14	FK24	FK34	FK44	FK54	FK64	FK74	FK84	FK94	+5	
+4	DJ03	DJ13	DJ23	DJ33	DJ43	DJ53	DJ63	DJ73	DJ83	DJ93	EL03	EL13	EL23	EL33	EL43	EL53	EL63	EL73	EL83	EL93	FK03	FK13	FK23	FK33	FK43	FK53	FK63	FK73	FK83	FK93	+4	
+3	DJ02	DJ12	DJ22	DJ32	DJ42	DJ52	DJ62	DJ72	DJ82	DJ92	EL02	EL12	EL22	EL32	EL42	EL52	EL62	EL72	EL82	EL92	FK02	FK12	FK22	FK32	FK42	FK52	FK62	FK72	FK82	FK92	+3	
+2	DJ01	DJ11	DJ21	DJ31	DJ41	DJ51	DJ61	DJ71	DJ81	DJ91	EL01	EL11	EL21	EL31	EL41	EL51	EL61	EL71	EL81	EL91	FK01	FK11	FK21	FK31	FK41	FK51	FK61	FK71	FK81	FK91	+2	
+1	DJ00	DJ10	DJ20	DJ30	DJ40	DJ50	DJ60	DJ70	DJ80	DJ90	EL00	EL10	EL20	EL30	EL40	EL50	EL60	EL70	EL80	EL90	FK00	FK10	FK20	FK30	FK40	FK50	FK60	FK70	FK80	FK90	+1	
0	DI09	DI19	DI29	DI39	DI49	DI59	DI69	DI79	DI89	DI99	EL09	EL19	EL29	EL39	EL49	EL59	EL69	EL79	EL89	EL99	FK09	FK19	FK29	FK39	FK49	FK59	FK69	FK79	FK89	FK99	0	
-1	DI08	DI18	DI28	DI38	DI48	DI58	DI68	DI78	DI88	DI98	EL08	EL18	EL28	EL38	EL48	EL58	EL68	EL78	EL88	EL98	FK08	FK18	FK28	FK38	FK48	FK58	FK68	FK78	FK88	FK98	-1	
-2	DI07	DI17	DI27	DI37	DI47	DI57	DI67	DI77	DI87	DI97	EL07	EL17	EL27	EL37	EL47	EL57	EL67	EL77	EL87	EL97	FK07	FK17	FK27	FK37	FK47	FK57	FK67	FK77	FK87	FK97	-2	
-3	DI06	DI16	DI26	DI36	DI46	DI56	DI66	DI76	DI86	DI96	EL06	EL16	EL26	EL36	EL46	EL56	EL66	EL76	EL86	EL96	FK06	FK16	FK26	FK36	FK46	FK56	FK66	FK76	FK86	FK96	-3	
-4	DI05	DI15	DI25	DI35	DI45	DI55	DI65	DI75	DI85	DI95	EL05	EL15	EL25	EL35	EL45	EL55	EL65	EL75	EL85	EL95	FK05	FK15	FK25	FK35	FK45	FK55	FK65	FK75	FK85	FK95	-4	
-5	DI04	DI14	DI24	DI34	DI44	DI54	DI64	DI74	DI84	DI94	EL04	EL14	EL24	EL34	EL44	EL54	EL64	EL74	EL84	EL94	FK04	FK14	FK24	FK34	FK44	FK54	FK64	FK74	FK84	FK94	-5	
-6	DI03	DI13	DI23	DI33	DI43	DI53	DI63	DI73	DI83	DI93	EL03	EL13	EL23	EL33	EL43	EL53	EL63	EL73	EL83	EL93	FK03	FK13	FK23	FK33	FK43	FK53	FK63	FK73	FK83	FK93	-6	
-7	DI02	DI12	DI22	DI32	DI42	DI52	DI62	DI72	DI82	DI92	EL02	EL12	EL22	EL32	EL42	EL52	EL62	EL72	EL82	EL92	FK02	FK12	FK22	FK32	FK42	FK52	FK62	FK72	FK82	FK92	-7	
-8	DI01	DI11	DI21	DI31	DI41	DI51	DI61	DI71	DI81	DI91	EL01	EL11	EL21	EL31	EL41	EL51	EL61	EL71	EL81	EL91	FK01	FK11	FK21	FK31	FK41	FK51	FK61	FK71	FK81	FK91	-8	
-9	DI00	DI10	DI20	DI30	DI40	DI50	DI60	DI70	DI80	DI90	EL00	EL10	EL20	EL30	EL40	EL50	EL60	EL70	EL80	EL90	FK00	FK10	FK20	FK30	FK40	FK50	FK60	FK70	FK80	FK90	-9	
-10	DH09	DH19	DH29	DH39	DH49	DH59	DH69	DH79	DH89	DH99	EL09	EL19	EL29	EL39	EL49	EL59	EL69	EL79	EL89	EL99	FK09	FK19	FK29	FK39	FK49	FK59	FK69	FK79	FK89	FK99	-10	
-11	DH08	DH18	DH28	DH38	DH48	DH58	DH68	DH78	DH88	DH98	EL08	EL18	EL28	EL38	EL48	EL58	EL68	EL78	EL88	EL98	FK08	FK18	FK28	FK38	FK48	FK58	FK68	FK78	FK88	FK98	-11	
-12	DH07	DH17	DH27	DH37	DH47	DH57	DH67	DH77	DH87	DH97	EL07	EL17	EL27	EL37	EL47	EL57	EL67	EL77	EL87	EL97	FK07	FK17	FK27	FK37	FK47	FK57	FK67	FK77	FK87	FK97	-12	
-13	DH06	DH16	DH26	DH36	DH46	DH56	DH66	DH76	DH86	DH96	EL06	EL16	EL26	EL36	EL46	EL56	EL66	EL76	EL86	EL96	FK06	FK16	FK26	FK36	FK46	FK56	FK66	FK76	FK86	FK96	-13	
-14	DH05	DH15	DH25	DH35	DH45	DH55	DH65	DH75	DH85	DH95	EL05	EL15	EL25	EL35	EL45	EL55	EL65	EL75	EL85	EL95	FK05	FK15	FK25	FK35	FK45	FK55	FK65	FK75	FK85	FK95	-14	
-15	DH04	DH14	DH24	DH34	DH44	DH54	DH64	DH74	DH84	DH94	EL04	EL14	EL24	EL34	EL44	EL54	EL64	EL74	EL84	EL94	FK04	FK14	FK24	FK34	FK44	FK54	FK64	FK74	FK84	FK94	-15	
-16	DH03	DH13	DH23	DH33	DH43	DH53	DH63	DH73	DH83	DH93	EL03	EL13	EL23	EL33	EL43	EL53	EL63	EL73	EL83	EL93	FK03	FK13	FK23</									







	-60	-58	-56	-54	-52	-50	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	+0	
-30	GF09	GF17	GF29	GF39	GF49	GF59	GF69	GF79	GF89	GF99	HF09	HF19	HF29	HF39	HF49	HF59	HF69	HF79	HF89	HF99	IF09	IF19	IF29	IF39	IF49	IF59	IF69	IF79	IF89	IF99		-30
-31	GF08	GF18	GF28	GF38	GF48	GF58	GF68	GF78	GF88	GF98	HF08	HF18	HF28	HF38	HF48	HF58	HF68	HF78	HF88	HF98	IF08	IF18	IF28	IF38	IF48	IF58	IF68	IF78	IF88	IF98		-31
-32	GF07	GF17	GF27	GF37	GF47	GF57	GF67	GF77	GF87	GF97	HF07	HF17	HF27	HF37	HF47	HF57	HF67	HF77	HF87	HF97	IF07	IF17	IF27	IF37	IF47	IF57	IF67	IF77	IF87	IF97		-32
-33	GF06	GF16	GF26	GF36	GF46	GF56	GF66	GF76	GF86	GF96	HF06	HF16	HF26	HF36	HF46	HF56	HF66	HF76	HF86	HF96	IF06	IF16	IF26	IF36	IF46	IF56	IF66	IF76	IF86	IF96		-33
-34	GF05	GF15	GF25	GF35	GF45	GF55	GF65	GF75	GF85	GF95	HF05	HF15	HF25	HF35	HF45	HF55	HF65	HF75	HF85	HF95	IF05	IF15	IF25	IF35	IF45	IF55	IF65	IF75	IF85	IF95		-34
-35	GF04	GF14	GF24	GF34	GF44	GF54	GF64	GF74	GF84	GF94	HF04	HF14	HF24	HF34	HF44	HF54	HF64	HF74	HF84	HF94	IF04	IF14	IF24	IF34	IF44	IF54	IF64	IF74	IF84	IF94		-35
-36	GF03	GF13	GF23	GF33	GF43	GF53	GF63	GF73	GF83	GF93	HF03	HF13	HF23	HF33	HF43	HF53	HF63	HF73	HF83	HF93	IF03	IF13	IF23	IF33	IF43	IF53	IF63	IF73	IF83	IF93		-36
-37	GF02	GF12	GF22	GF32	GF42	GF52	GF62	GF72	GF82	GF92	HF02	HF12	HF22	HF32	HF42	HF52	HF62	HF72	HF82	HF92	IF02	IF12	IF22	IF32	IF42	IF52	IF62	IF72	IF82	IF92		-37
-38	GF01	GF11	GF21	GF31	GF41	GF51	GF61	GF71	GF81	GF91	HF01	HF11	HF21	HF31	HF41	HF51	HF61	HF71	HF81	HF91	IF01	IF11	IF21	IF31	IF41	IF51	IF61	IF71	IF81	IF91		-38
-39	GF00	GF10	GF20	GF30	GF40	GF50	GF60	GF70	GF80	GF90	HF00	HF10	HF20	HF30	HF40	HF50	HF60	HF70	HF80	HF90	IF00	IF10	IF20	IF30	IF40	IF50	IF60	IF70	IF80	IF90		-39
-40	GE09	GE19	GE29	GE39	GE49	GE59	GE69	GE79	GE89	GE99	HE09	HE19	HE29	HE39	HE49	HE59	HE69	HE79	HE89	HE99	IE09	IE19	IE29	IE39	IE49	IE59	IE69	IE79	IE89	IE99		-40
-41	GE08	GE18	GE28	GE38	GE48	GE58	GE68	GE78	GE88	GE98	HE08	HE18	HE28	HE38	HE48	HE58	HE68	HE78	HE88	HE98	IE08	IE18	IE28	IE38	IE48	IE58	IE68	IE78	IE88	IE98		-41
-42	GE07	GE17	GE27	GE37	GE47	GE57	GE67	GE77	GE87	GE97	HE07	HE17	HE27	HE37	HE47	HE57	HE67	HE77	HE87	HE97	IE07	IE17	IE27	IE37	IE47	IE57	IE67	IE77	IE87	IE97		-42
-43	GE06	GE16	GE26	GE36	GE46	GE56	GE66	GE76	GE86	GE96	HE06	HE16	HE26	HE36	HE46	HE56	HE66	HE76	HE86	HE96	IE06	IE16	IE26	IE36	IE46	IE56	IE66	IE76	IE86	IE96		-43
-44	GE05	GE15	GE25	GE35	GE45	GE55	GE65	GE75	GE85	GE95	HE05	HE15	HE25	HE35	HE45	HE55	HE65	HE75	HE85	HE95	IE05	IE15	IE25	IE35	IE45	IE55	IE65	IE75	IE85	IE95		-44
-45	GE04	GE14	GE24	GE34	GE44	GE54	GE64	GE74	GE84	GE94	HE04	HE14	HE24	HE34	HE44	HE54	HE64	HE74	HE84	HE94	IE04	IE14	IE24	IE34	IE44	IE54	IE64	IE74	IE84	IE94		-45
-46	GE03	GE13	GE23	GE33	GE43	GE53	GE63	GE73	GE83	GE93	HE03	HE13	HE23	HE33	HE43	HE53	HE63	HE73	HE83	HE93	IE03	IE13	IE23	IE33	IE43	IE53	IE63	IE73	IE83	IE93		-46
-47	GE02	GE12	GE22	GE32	GE42	GE52	GE62	GE72	GE82	GE92	HE02	HE12	HE22	HE32	HE42	HE52	HE62	HE72	HE82	HE92	IE02	IE12	IE22	IE32	IE42	IE52	IE62	IE72	IE82	IE92		-47
-48	GE01	GE11	GE21	GE31	GE41	GE51	GE61	GE71	GE81	GE91	HE01	HE11	HE21	HE31	HE41	HE51	HE61	HE71	HE81	HE91	IE01	IE11	IE21	IE31	IE41	IE51	IE61	IE71	IE81	IE91		-48
-49	GE00	GE10	GE20	GE30	GE40	GE50	GE60	GE70	GE80	GE90	HE00	HE10	HE20	HE30	HE40	HE50	HE60	HE70	HE80	HE90	IE00	IE10	IE20	IE30	IE40	IE50	IE60	IE70	IE80	IE90		-49
-50	GD09	GD19	GD29	GD39	GD49	GD59	GD69	GD79	GD89	GD99	HD09	HD19	HD29	HD39	HD49	HD59	HD69	HD79	HD89	HD99	ID09	ID19	ID29	ID39	ID49	ID59	ID69	ID79	ID89	ID99		-50
-51	GD08	GD18	GD28	GD38	GD48	GD58	GD68	GD78	GD88	GD98	HD08	HD18	HD28	HD38	HD48	HD58	HD68	HD78	HD88	HD98	ID08	ID18	ID28	ID38	ID48	ID58	ID68	ID78	ID88	ID98		-51
-52	GD07	GD17	GD27	GD37	GD47	GD57	GD67	GD77	GD87	GD97	HD07	HD17	HD27	HD37	HD47	HD57	HD67	HD77	HD87	HD97	ID07	ID17	ID27	ID37	ID47	ID57	ID67	ID77	ID87	ID97		-52
-53	GD06	GD16	GD26	GD36	GD46	GD56	GD66	GD76	GD86	GD96	HD06	HD16	HD26	HD36	HD46	HD56	HD66	HD76	HD86	HD96	ID06	ID16	ID26	ID36	ID46	ID56	ID66	ID76	ID86	ID96		-53
-54	GD05	GD15	GD25	GD35	GD45	GD55	GD65	GD75	GD85	GD95	HD05	HD15	HD25	HD35	HD45	HD55	HD65	HD75	HD85	HD95	ID05	ID15	ID25	ID35	ID45	ID55	ID65	ID75	ID85	ID95		-54
-55	GD04	GD14	GD24	GD34	GD44	GD54	GD64	GD74	GD84	GD94	HD04	HD14	HD24	HD34	HD44	HD54	HD64	HD74	HD84	HD94	ID04	ID14	ID24	ID34	ID44	ID54	ID64	ID74	ID84	ID94		-55
-56	GD03	GD13	GD23	GD33	GD43	GD53	GD63	GD73	GD83	GD93	HD03	HD13	HD23	HD33	HD43	HD53	HD63	HD73	HD83	HD93	ID03	ID13	ID23	ID33	ID43	ID53	ID63	ID73	ID83	ID93		-56
-57	GD02	GD12	GD22	GD32	GD42	GD52	GD62	GD72	GD82	GD92	HD02	HD12	HD22	HD32	HD42	HD52	HD62	HD72	HD82	HD92	ID02	ID12	ID22	ID32	ID42	ID52	ID62	ID72	ID82	ID92		-57
-58	GD01	GD11	GD21	GD31	GD41	GD51	GD61	GD71	GD81	GD91	HD01	HD11	HD21	HD31	HD41	HD51	HD61	HD71	HD81	HD91	ID01	ID11	ID21	ID31	ID41	ID51	ID61	ID71	ID81	ID91		-58
-59	GD00	GD10	GD20	GD30	GD40	GD50	GD60	GD70	GD80	GD90	HD00	HD10	HD20	HD30	HD40	HD50	HD60	HD70	HD80	HD90	ID00	ID10	ID20	ID30	ID40	ID50	ID60	ID70	ID80	ID90		-59
-60	GC09	GC19	GC29	GC39	GC49	GC59	GC69	GC79	GC89	GC99	HC09	HC19	HC29	HC39	HC49	HC59	HC69	HC79	HC89	HC99	IC09	IC19	IC29	IC39	IC49	IC59	IC69	IC79	IC89	IC99		-60
-61	GC08	GC18	GC28	GC38	GC48	GC58	GC68	GC78	GC88	GC98	HC08	HC18	HC28	HC38	HC48	HC58	HC68	HC78	HC88	HC98	IC08	IC18	IC28	IC38	IC48	IC58	IC68	IC78	IC88	IC98		-61
-62	GC07	GC17	GC27	GC37	GC47	GC57	GC67	GC77	GC87	GC97	HC07	HC17	HC27	HC37	HC47	HC57	HC67	HC77	HC87	HC97	IC07	IC17	IC27	IC37	IC47	IC57	IC67	IC77	IC87	IC97		-62
-63	GC06	GC16	GC26	GC36	GC46	GC56	GC66	GC76	GC86	GC96	HC06	HC16	HC26	HC36	HC46	HC56	HC66	HC76	HC86	HC96	IC06	IC16	IC26	IC36	IC46	IC56	IC66	IC76	IC86	IC96		-63
-64	GC05	GC15	GC25	GC35	GC45	GC55	GC65	GC75	GC85	GC95	HC05	HC15	HC25	HC35	HC45	HC55	HC65	HC75	HC85	HC95	IC05	IC15	IC25	IC35	IC45	IC55	IC65	IC75	IC85	IC95		-64
-65	GC04	GC14	GC24	GC34	GC44	GC54	GC64	GC74	GC84	GC94	HC04	HC14	HC24	HC34	HC44	HC54	HC64	HC74	HC84	HC94	IC04	IC14	IC24	IC34	IC44	IC54	IC64	IC74	IC84	IC94		-65
-66	GC03	GC13	GC23	GC33	GC43	GC53	GC63	GC73	GC83	GC93	HC03	HC13	HC23	HC33	HC43	HC53	HC63	HC73	HC83	HC93	IC03	IC13	IC23	IC33	IC43	IC53	IC63	IC73	IC83	IC93		-66
-67	GC02	GC12	GC22	GC32	GC42	GC52	GC62	GC72	GC82	GC92	HC02	HC12	HC22	HC32	HC42	HC52	HC62	HC72	HC82	HC92	IC02	IC12	IC22	IC32	IC42	IC52	IC62	IC72	IC82	IC92		-67
-68	GC01	GC11	GC21	GC31	GC41	GC51	GC61	GC71	GC81	GC91	HC01	HC11	HC21	HC31	HC41	HC51	HC61	HC71	HC81	HC91	IC01	IC11	IC21	IC31	IC41	IC51	IC61	IC71	IC81	IC91		-68
-69	GC00	GC10	GC20	GC30	GC40	GC50	GC60	GC70	GC80	GC90	HC00	HC10	HC20	HC30	HC40	HC50	HC60	HC70	HC80	HC90	IC00	IC10	IC20	IC30	IC40	IC50	IC60	IC70	IC80	IC90		-69
-70	GB09	GB19	GB29	GB39	GB49	GB59	GB69	GB79	GB89	GB99	HB09	HB19	HB29	HB39	HB49	HB59	HB69	HB79	HB89	HB99	IB09	IB19	IB29	IB39	IB49	IB59	IB69	IB79	IB89	IB99		-70
-71	GB08	GB18	GB28	GB38	GB48	GB58	GB68	GB78	GB88	GB98	HB08	HB18	HB28	HB38	HB48	HB58	HB68	HB78	HB88	HB98	IB08	IB18	IB28	IB38	IB48	IB58	IB68	IB78	IB88	IB98		-71
-72	GB07	GB17	GB27	GB37	GB47	GB57	GB67	GB77	GB87	GB97	HB07	HB17	HB27	HB37	HB47	HB57	HB67	HB77	HB87	HB97	IB07	IB17	IB27	IB37	IB47	IB57	IB67	IB77	IB87	IB97		-72
-73	GB06	GB16	GB26	GB36	GB46	GB56	GB66	GB76	GB86	GB96	HB06	HB16	HB26	HB36	HB46	HB56	HB66	HB76	HB86	HB96	IB06	IB16	IB26	IB36	IB46	IB56	IB66	IB76	IB86	IB96		-73
-74	GB05	GB15	GB25	GB35	GB45	GB55	GB65	GB75	GB85	GB95	HB05	HB15	HB25	HB35	HB45	HB55	HB65	HB75	HB85	HB95	IB05	IB15	IB25	IB35	IB45	IB55	IB65	IB75	IB85	IB95		-74
-75	GB04	GB14	GB24	GB34	GB44	GB54	GB64	GB74	GB84	GB94	HB04	HB14	HB24	HB34	HB44	HB54	HB64	HB74	HB84	HB94	IB04	IB14	IB24	IB34	IB44	IB54	IB64	IB74	IB84	IB94		-75
-76	GB03	GB13	GB23	GB33	GB43	GB53	GB63	GB73	GB83	GB93	HB03	HB13	HB23	HB33	HB43	HB																



	-60	-58	-56	-54	-52	-50	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	+0	
+30	GL09	GL19	GL29	GL39	GL49	GL59	GL69	GL79	GL89	GL99	HL09	HL19	HL29	HL39	HL49	HL59	HL69	HL79	HL89	HL99	LO09	LO19	LO29	LO39	LO49	LO59	LO69	LO79	LO89	LO99		+30
+29	GL08	GL18	GL28	GL38	GL48	GL58	GL68	GL78	GL88	GL98	HL08	HL18	HL28	HL38	HL48	HL58	HL68	HL78	HL88	HL98	LO08	LO18	LO28	LO38	LO48	LO58	LO68	LO78	LO88	LO98		+29
+28	GL07	GL17	GL27	GL37	GL47	GL57	GL67	GL77	GL87	GL97	HL07	HL17	HL27	HL37	HL47	HL57	HL67	HL77	HL87	HL97	LO07	LO17	LO27	LO37	LO47	LO57	LO67	LO77	LO87	LO97		+28
+27	GL06	GL16	GL26	GL36	GL46	GL56	GL66	GL76	GL86	GL96	HL06	HL16	HL26	HL36	HL46	HL56	HL66	HL76	HL86	HL96	LO06	LO16	LO26	LO36	LO46	LO56	LO66	LO76	LO86	LO96		+27
+26	GL05	GL15	GL25	GL35	GL45	GL55	GL65	GL75	GL85	GL95	HL05	HL15	HL25	HL35	HL45	HL55	HL65	HL75	HL85	HL95	LO05	LO15	LO25	LO35	LO45	LO55	LO65	LO75	LO85	LO95		+26
+25	GL04	GL14	GL24	GL34	GL44	GL54	GL64	GL74	GL84	GL94	HL04	HL14	HL24	HL34	HL44	HL54	HL64	HL74	HL84	HL94	LO04	LO14	LO24	LO34	LO44	LO54	LO64	LO74	LO84	LO94		+25
+24	GL03	GL13	GL23	GL33	GL43	GL53	GL63	GL73	GL83	GL93	HL03	HL13	HL23	HL33	HL43	HL53	HL63	HL73	HL83	HL93	LO03	LO13	LO23	LO33	LO43	LO53	LO63	LO73	LO83	LO93		+24
+23	GL02	GL12	GL22	GL32	GL42	GL52	GL62	GL72	GL82	GL92	HL02	HL12	HL22	HL32	HL42	HL52	HL62	HL72	HL82	HL92	LO02	LO12	LO22	LO32	LO42	LO52	LO62	LO72	LO82	LO92		+23
+22	GL01	GL11	GL21	GL31	GL41	GL51	GL61	GL71	GL81	GL91	HL01	HL11	HL21	HL31	HL41	HL51	HL61	HL71	HL81	HL91	LO01	LO11	LO21	LO31	LO41	LO51	LO61	LO71	LO81	LO91		+22
+21	GL00	GL10	GL20	GL30	GL40	GL50	GL60	GL70	GL80	GL90	HL00	HL10	HL20	HL30	HL40	HL50	HL60	HL70	HL80	HL90	LO00	LO10	LO20	LO30	LO40	LO50	LO60	LO70	LO80	LO90		+21
+20	GK09	GK19	GK29	GK39	GK49	GK59	GK69	GK79	GK89	GK99	HK09	HK19	HK29	HK39	HK49	HK59	HK69	HK79	HK89	HK99	IK09	IK19	IK29	IK39	IK49	IK59	IK69	IK79	IK89	IK99		+20
+19	GK08	GK18	GK28	GK38	GK48	GK58	GK68	GK78	GK88	GK98	HK08	HK18	HK28	HK38	HK48	HK58	HK68	HK78	HK88	HK98	IK08	IK18	IK28	IK38	IK48	IK58	IK68	IK78	IK88	IK98		+19
+18	GK07	GK17	GK27	GK37	GK47	GK57	GK67	GK77	GK87	GK97	HK07	HK17	HK27	HK37	HK47	HK57	HK67	HK77	HK87	HK97	IK07	IK17	IK27	IK37	IK47	IK57	IK67	IK77	IK87	IK97		+18
+17	GK06	GK16	GK26	GK36	GK46	GK56	GK66	GK76	GK86	GK96	HK06	HK16	HK26	HK36	HK46	HK56	HK66	HK76	HK86	HK96	IK06	IK16	IK26	IK36	IK46	IK56	IK66	IK76	IK86	IK96		+17
+16	GK05	GK15	GK25	GK35	GK45	GK55	GK65	GK75	GK85	GK95	HK05	HK15	HK25	HK35	HK45	HK55	HK65	HK75	HK85	HK95	IK05	IK15	IK25	IK35	IK45	IK55	IK65	IK75	IK85	IK95		+16
+15	GK04	GK14	GK24	GK34	GK44	GK54	GK64	GK74	GK84	GK94	HK04	HK14	HK24	HK34	HK44	HK54	HK64	HK74	HK84	HK94	IK04	IK14	IK24	IK34	IK44	IK54	IK64	IK74	IK84	IK94		+15
+14	GK03	GK13	GK23	GK33	GK43	GK53	GK63	GK73	GK83	GK93	HK03	HK13	HK23	HK33	HK43	HK53	HK63	HK73	HK83	HK93	IK03	IK13	IK23	IK33	IK43	IK53	IK63	IK73	IK83	IK93		+14
+13	GK02	GK12	GK22	GK32	GK42	GK52	GK62	GK72	GK82	GK92	HK02	HK12	HK22	HK32	HK42	HK52	HK62	HK72	HK82	HK92	IK02	IK12	IK22	IK32	IK42	IK52	IK62	IK72	IK82	IK92		+13
+12	GK01	GK11	GK21	GK31	GK41	GK51	GK61	GK71	GK81	GK91	HK01	HK11	HK21	HK31	HK41	HK51	HK61	HK71	HK81	HK91	IK01	IK11	IK21	IK31	IK41	IK51	IK61	IK71	IK81	IK91		+12
+11	GK00	GK10	GK20	GK30	GK40	GK50	GK60	GK70	GK80	GK90	HK00	HK10	HK20	HK30	HK40	HK50	HK60	HK70	HK80	HK90	IK00	IK10	IK20	IK30	IK40	IK50	IK60	IK70	IK80	IK90		+11
+10	GJ09	GJ19	GJ29	GJ39	GJ49	GJ59	GJ69	GJ79	GJ89	GJ99	HJ09	HJ19	HJ29	HJ39	HJ49	HJ59	HJ69	HJ79	HJ89	HJ99	IJ09	IJ19	IJ29	IJ39	IJ49	IJ59	IJ69	IJ79	IJ89	IJ99		+10
+9	GJ08	GJ18	GJ28	GJ38	GJ48	GJ58	GJ68	GJ78	GJ88	GJ98	HJ08	HJ18	HJ28	HJ38	HJ48	HJ58	HJ68	HJ78	HJ88	HJ98	IJ08	IJ18	IJ28	IJ38	IJ48	IJ58	IJ68	IJ78	IJ88	IJ98		+9
+8	GJ07	GJ17	GJ27	GJ37	GJ47	GJ57	GJ67	GJ77	GJ87	GJ97	HJ07	HJ17	HJ27	HJ37	HJ47	HJ57	HJ67	HJ77	HJ87	HJ97	IJ07	IJ17	IJ27	IJ37	IJ47	IJ57	IJ67	IJ77	IJ87	IJ97		+8
+7	GJ06	GJ16	GJ26	GJ36	GJ46	GJ56	GJ66	GJ76	GJ86	GJ96	HJ06	HJ16	HJ26	HJ36	HJ46	HJ56	HJ66	HJ76	HJ86	HJ96	IJ06	IJ16	IJ26	IJ36	IJ46	IJ56	IJ66	IJ76	IJ86	IJ96		+7
+6	GJ05	GJ15	GJ25	GJ35	GJ45	GJ55	GJ65	GJ75	GJ85	GJ95	HJ05	HJ15	HJ25	HJ35	HJ45	HJ55	HJ65	HJ75	HJ85	HJ95	IJ05	IJ15	IJ25	IJ35	IJ45	IJ55	IJ65	IJ75	IJ85	IJ95		+6
+5	GJ04	GJ14	GJ24	GJ34	GJ44	GJ54	GJ64	GJ74	GJ84	GJ94	HJ04	HJ14	HJ24	HJ34	HJ44	HJ54	HJ64	HJ74	HJ84	HJ94	IJ04	IJ14	IJ24	IJ34	IJ44	IJ54	IJ64	IJ74	IJ84	IJ94		+5
+4	GJ03	GJ13	GJ23	GJ33	GJ43	GJ53	GJ63	GJ73	GJ83	GJ93	HJ03	HJ13	HJ23	HJ33	HJ43	HJ53	HJ63	HJ73	HJ83	HJ93	IJ03	IJ13	IJ23	IJ33	IJ43	IJ53	IJ63	IJ73	IJ83	IJ93		+4
+3	GJ02	GJ12	GJ22	GJ32	GJ42	GJ52	GJ62	GJ72	GJ82	GJ92	HJ02	HJ12	HJ22	HJ32	HJ42	HJ52	HJ62	HJ72	HJ82	HJ92	IJ02	IJ12	IJ22	IJ32	IJ42	IJ52	IJ62	IJ72	IJ82	IJ92		+3
+2	GJ01	GJ11	GJ21	GJ31	GJ41	GJ51	GJ61	GJ71	GJ81	GJ91	HJ01	HJ11	HJ21	HJ31	HJ41	HJ51	HJ61	HJ71	HJ81	HJ91	IJ01	IJ11	IJ21	IJ31	IJ41	IJ51	IJ61	IJ71	IJ81	IJ91		+2
+1	GJ00	GJ10	GJ20	GJ30	GJ40	GJ50	GJ60	GJ70	GJ80	GJ90	HJ00	HJ10	HJ20	HJ30	HJ40	HJ50	HJ60	HJ70	HJ80	HJ90	IJ00	IJ10	IJ20	IJ30	IJ40	IJ50	IJ60	IJ70	IJ80	IJ90		+1
+0	GI09	GI19	GI29	GI39	GI49	GI59	GI69	GI79	GI89	GI99	HI09	HI19	HI29	HI39	HI49	HI59	HI69	HI79	HI89	HI99	II09	II19	II29	II39	II49	II59	II69	II79	II89	II99		+0
-1	GI08	GI18	GI28	GI38	GI48	GI58	GI68	GI78	GI88	GI98	HI08	HI18	HI28	HI38	HI48	HI58	HI68	HI78	HI88	HI98	II08	II18	II28	II38	II48	II58	II68	II78	II88	II98		-1
-2	GI07	GI17	GI27	GI37	GI47	GI57	GI67	GI77	GI87	GI97	HI07	HI17	HI27	HI37	HI47	HI57	HI67	HI77	HI87	HI97	II07	II17	II27	II37	II47	II57	II67	II77	II87	II97		-2
-3	GI06	GI16	GI26	GI36	GI46	GI56	GI66	GI76	GI86	GI96	HI06	HI16	HI26	HI36	HI46	HI56	HI66	HI76	HI86	HI96	II06	II16	II26	II36	II46	II56	II66	II76	II86	II96		-3
-4	GI05	GI15	GI25	GI35	GI45	GI55	GI65	GI75	GI85	GI95	HI05	HI15	HI25	HI35	HI45	HI55	HI65	HI75	HI85	HI95	II05	II15	II25	II35	II45	II55	II65	II75	II85	II95		-4
-5	GI04	GI14	GI24	GI34	GI44	GI54	GI64	GI74	GI84	GI94	HI04	HI14	HI24	HI34	HI44	HI54	HI64	HI74	HI84	HI94	II04	II14	II24	II34	II44	II54	II64	II74	II84	II94		-5
-6	GI03	GI13	GI23	GI33	GI43	GI53	GI63	GI73	GI83	GI93	HI03	HI13	HI23	HI33	HI43	HI53	HI63	HI73	HI83	HI93	II03	II13	II23	II33	II43	II53	II63	II73	II83	II93		-6
-7	GI02	GI12	GI22	GI32	GI42	GI52	GI62	GI72	GI82	GI92	HI02	HI12	HI22	HI32	HI42	HI52	HI62	HI72	HI82	HI92	II02	II12	II22	II32	II42	II52	II62	II72	II82	II92		-7
-8	GI01	GI11	GI21	GI31	GI41	GI51	GI61	GI71	GI81	GI91	HI01	HI11	HI21	HI31	HI41	HI51	HI61	HI71	HI81	HI91	II01	II11	II21	II31	II41	II51	II61	II71	II81	II91		-8
-9	GI00	GI10	GI20	GI30	GI40	GI50	GI60	GI70	GI80	GI90	HI00	HI10	HI20	HI30	HI40	HI50	HI60	HI70	HI80	HI90	II00	II10	II20	II30	II40	II50	II60	II70	II80	II90		-9
-10	GH09	GH19	GH29	GH39	GH49	GH59	GH69	GH79	GH89	GH99	HH09	HH19	HH29	HH39	HH49	HH59	HH69	HH79	HH89	HH99	IH09	IH19	IH29	IH39	IH49	IH59	IH69	IH79	IH89	IH99		-10
-11	GH08	GH18	GH28	GH38	GH48	GH58	GH68	GH78	GH88	GH98	HH08	HH18	HH28	HH38	HH48	HH58	HH68	HH78	HH88	HH98	IH08	IH18	IH28	IH38	IH48	IH58	IH68	IH78	IH88	IH98		-11
-12	GH07	GH17	GH27	GH37	GH47	GH57	GH67	GH77	GH87	GH97	HH07	HH17	HH27	HH37	HH47	HH57	HH67	HH77	HH87	HH97	IH07	IH17	IH27	IH37	IH47	IH57	IH67	IH77	IH87	IH97		-12
-13	GH06	GH16	GH26	GH36	GH46	GH56	GH66	GH76	GH86	GH96	HH06	HH16	HH26	HH36	HH46	HH56	HH66	HH76	HH86	HH96	IH06	IH16	IH26	IH36	IH46	IH56	IH66	IH76	IH86	IH96		-13
-14	GH05	GH15	GH25	GH35	GH45	GH55	GH65	GH75	GH85	GH95	HH05	HH15	HH25	HH35	HH45	HH55	HH65	HH75	HH85	HH95	IH05	IH15	IH25	IH35	IH45	IH55	IH65	IH75	IH85	IH95		-14
-15	GH04	GH14	GH24	GH34	GH44	GH54	GH64	GH74	GH84	GH94	HH04	HH14	HH24	HH34	HH44	HH54	HH64	HH74	HH84	HH94	IH04	IH14	IH24	IH34	IH44	IH54	IH64	IH74	IH84	IH94		-15
-16	GH03	GH13																														



	-60	-58	-56	-54	-52	-50	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	+0	
+90	GR09	GR19	GR29	GR39	GR49	GR59	GR69	GR79	GR89	GR99	HR09	HR19	HR29	HR39	HR49	HR59	HR69	HR79	HR89	HR99	IR09	IR19	IR29	IR39	IR49	IR59	IR69	IR79	IR89	IR99	+90	
+89	GR08	GR18	GR28	GR38	GR48	GR58	GR68	GR78	GR88	GR98	HR08	HR18	HR28	HR38	HR48	HR58	HR68	HR78	HR88	HR98	IR08	IR18	IR28	IR38	IR48	IR58	IR68	IR78	IR88	IR98	+89	
+88	GR07	GR17	GR27	GR37	GR47	GR57	GR67	GR77	GR87	GR97	HR07	HR17	HR27	HR37	HR47	HR57	HR67	HR77	HR87	HR97	IR07	IR17	IR27	IR37	IR47	IR57	IR67	IR77	IR87	IR97	+88	
+87	GR06	GR16	GR26	GR36	GR46	GR56	GR66	GR76	GR86	GR96	HR06	HR16	HR26	HR36	HR46	HR56	HR66	HR76	HR86	HR96	IR06	IR16	IR26	IR36	IR46	IR56	IR66	IR76	IR86	IR96	+87	
+86	GR05	GR15	GR25	GR35	GR45	GR55	GR65	GR75	GR85	GR95	HR05	HR15	HR25	HR35	HR45	HR55	HR65	HR75	HR85	HR95	IR05	IR15	IR25	IR35	IR45	IR55	IR65	IR75	IR85	IR95	+86	
+85	GR04	GR14	GR24	GR34	GR44	GR54	GR64	GR74	GR84	GR94	HR04	HR14	HR24	HR34	HR44	HR54	HR64	HR74	HR84	HR94	IR04	IR14	IR24	IR34	IR44	IR54	IR64	IR74	IR84	IR94	+85	
+84	GR03	GR13	GR23	GR33	GR43	GR53	GR63	GR73	GR83	GR93	HR03	HR13	HR23	HR33	HR43	HR53	HR63	HR73	HR83	HR93	IR03	IR13	IR23	IR33	IR43	IR53	IR63	IR73	IR83	IR93	+84	
+83	GR02	GR12	GR22	GR32	GR42	GR52	GR62	GR72	GR82	GR92	HR02	HR12	HR22	HR32	HR42	HR52	HR62	HR72	HR82	HR92	IR02	IR12	IR22	IR32	IR42	IR52	IR62	IR72	IR82	IR92	+83	
+82	GR01	GR11	GR21	GR31	GR41	GR51	GR61	GR71	GR81	GR91	HR01	HR11	HR21	HR31	HR41	HR51	HR61	HR71	HR81	HR91	IR01	IR11	IR21	IR31	IR41	IR51	IR61	IR71	IR81	IR91	+82	
+81	GR00	GR10	GR20	GR30	GR40	GR50	GR60	GR70	GR80	GR90	HR00	HR10	HR20	HR30	HR40	HR50	HR60	HR70	HR80	HR90	IR00	IR10	IR20	IR30	IR40	IR50	IR60	IR70	IR80	IR90	+81	
+80	GQ09	GQ19	GQ29	GQ39	GQ49	GQ59	GQ69	GQ79	GQ89	GQ99	HQ09	HQ19	HQ29	HQ39	HQ49	HQ59	HQ69	HQ79	HQ89	HQ99	IQ09	IQ19	IQ29	IQ39	IQ49	IQ59	IQ69	IQ79	IQ89	IQ99	+80	
+79	Q008	Q018	Q028	Q038	Q048	Q058	Q068	Q078	Q088	Q098	HQ08	HQ18	HQ28	HQ38	HQ48	HQ58	HQ68	HQ78	HQ88	HQ98	IQ08	IQ18	IQ28	IQ38	IQ48	IQ58	IQ68	IQ78	IQ88	IQ98	+79	
+78	Q007	Q017	Q027	Q037	Q047	Q057	Q067	Q077	Q087	Q097	HQ07	HQ17	HQ27	HQ37	HQ47	HQ57	HQ67	HQ77	HQ87	HQ97	IQ07	IQ17	IQ27	IQ37	IQ47	IQ57	IQ67	IQ77	IQ87	IQ97	+78	
+77	Q006	Q016	Q026	Q036	Q046	Q056	Q066	Q076	Q086	Q096	HQ06	HQ16	HQ26	HQ36	HQ46	HQ56	HQ66	HQ76	HQ86	HQ96	IQ06	IQ16	IQ26	IQ36	IQ46	IQ56	IQ66	IQ76	IQ86	IQ96	+77	
+76	Q005	Q015	Q025	Q035	Q045	Q055	Q065	Q075	Q085	Q095	HQ05	HQ15	HQ25	HQ35	HQ45	HQ55	HQ65	HQ75	HQ85	HQ95	IQ05	IQ15	IQ25	IQ35	IQ45	IQ55	IQ65	IQ75	IQ85	IQ95	+76	
+75	Q004	Q014	Q024	Q034	Q044	Q054	Q064	Q074	Q084	Q094	HQ04	HQ14	HQ24	HQ34	HQ44	HQ54	HQ64	HQ74	HQ84	HQ94	IQ04	IQ14	IQ24	IQ34	IQ44	IQ54	IQ64	IQ74	IQ84	IQ94	+75	
+74	Q003	Q013	Q023	Q033	Q043	Q053	Q063	Q073	Q083	Q093	HQ03	HQ13	HQ23	HQ33	HQ43	HQ53	HQ63	HQ73	HQ83	HQ93	IQ03	IQ13	IQ23	IQ33	IQ43	IQ53	IQ63	IQ73	IQ83	IQ93	+74	
+73	Q002	Q012	Q022	Q032	Q042	Q052	Q062	Q072	Q082	Q092	HQ02	HQ12	HQ22	HQ32	HQ42	HQ52	HQ62	HQ72	HQ82	HQ92	IQ02	IQ12	IQ22	IQ32	IQ42	IQ52	IQ62	IQ72	IQ82	IQ92	+73	
+72	Q001	Q011	Q021	Q031	Q041	Q051	Q061	Q071	Q081	Q091	HQ01	HQ11	HQ21	HQ31	HQ41	HQ51	HQ61	HQ71	HQ81	HQ91	IQ01	IQ11	IQ21	IQ31	IQ41	IQ51	IQ61	IQ71	IQ81	IQ91	+72	
+71	Q000	Q010	Q020	Q030	Q040	Q050	Q060	Q070	Q080	Q090	HQ00	HQ10	HQ20	HQ30	HQ40	HQ50	HQ60	HQ70	HQ80	HQ90	IQ00	IQ10	IQ20	IQ30	IQ40	IQ50	IQ60	IQ70	IQ80	IQ90	+71	
+70	GP09	GP19	GP29	GP39	GP49	GP59	GP69	GP79	GP89	GP99	HP09	HP19	HP29	HP39	HP49	HP59	HP69	HP79	HP89	HP99	IP09	IP19	IP29	IP39	IP49	IP59	IP69	IP79	IP89	IP99	+70	
+69	GP08	GP18	GP28	GP38	GP48	GP58	GP68	GP78	GP88	GP98	HP08	HP18	HP28	HP38	HP48	HP58	HP68	HP78	HP88	HP98	IP08	IP18	IP28	IP38	IP48	IP58	IP68	IP78	IP88	IP98	+69	
+68	GP07	GP17	GP27	GP37	GP47	GP57	GP67	GP77	GP87	GP97	HP07	HP17	HP27	HP37	HP47	HP57	HP67	HP77	HP87	HP97	IP07	IP17	IP27	IP37	IP47	IP57	IP67	IP77	IP87	IP97	+68	
+67	GP06	GP16	GP26	GP36	GP46	GP56	GP66	GP76	GP86	GP96	HP06	HP16	HP26	HP36	HP46	HP56	HP66	HP76	HP86	HP96	IP06	IP16	IP26	IP36	IP46	IP56	IP66	IP76	IP86	IP96	+67	
+66	GP05	GP15	GP25	GP35	GP45	GP55	GP65	GP75	GP85	GP95	HP05	HP15	HP25	HP35	HP45	HP55	HP65	HP75	HP85	HP95	IP05	IP15	IP25	IP35	IP45	IP55	IP65	IP75	IP85	IP95	+66	
+65	GP04	GP14	GP24	GP34	GP44	GP54	GP64	GP74	GP84	GP94	HP04	HP14	HP24	HP34	HP44	HP54	HP64	HP74	HP84	HP94	IP04	IP14	IP24	IP34	IP44	IP54	IP64	IP74	IP84	IP94	+65	
+64	GP03	GP13	GP23	GP33	GP43	GP53	GP63	GP73	GP83	GP93	HP03	HP13	HP23	HP33	HP43	HP53	HP63	HP73	HP83	HP93	IP03	IP13	IP23	IP33	IP43	IP53	IP63	IP73	IP83	IP93	+64	
+63	GP02	GP12	GP22	GP32	GP42	GP52	GP62	GP72	GP82	GP92	HP02	HP12	HP22	HP32	HP42	HP52	HP62	HP72	HP82	HP92	IP02	IP12	IP22	IP32	IP42	IP52	IP62	IP72	IP82	IP92	+63	
+62	GP01	GP11	GP21	GP31	GP41	GP51	GP61	GP71	GP81	GP91	HP01	HP11	HP21	HP31	HP41	HP51	HP61	HP71	HP81	HP91	IP01	IP11	IP21	IP31	IP41	IP51	IP61	IP71	IP81	IP91	+62	
+61	GP00	GP10	GP20	GP30	GP40	GP50	GP60	GP70	GP80	GP90	HP00	HP10	HP20	HP30	HP40	HP50	HP60	HP70	HP80	HP90	IP00	IP10	IP20	IP30	IP40	IP50	IP60	IP70	IP80	IP90	+61	
+60	GQ09	GQ19	GQ29	GQ39	GQ49	GQ59	GQ69	GQ79	GQ89	GQ99	HQ09	HQ19	HQ29	HQ39	HQ49	HQ59	HQ69	HQ79	HQ89	HQ99	IQ09	IQ19	IQ29	IQ39	IQ49	IQ59	IQ69	IQ79	IQ89	IQ99	+60	
+59	GQ08	GQ18	GQ28	GQ38	GQ48	GQ58	GQ68	GQ78	GQ88	GQ98	HQ08	HQ18	HQ28	HQ38	HQ48	HQ58	HQ68	HQ78	HQ88	HQ98	IQ08	IQ18	IQ28	IQ38	IQ48	IQ58	IQ68	IQ78	IQ88	IQ98	+59	
+58	GQ07	GQ17	GQ27	GQ37	GQ47	GQ57	GQ67	GQ77	GQ87	GQ97	HQ07	HQ17	HQ27	HQ37	HQ47	HQ57	HQ67	HQ77	HQ87	HQ97	IQ07	IQ17	IQ27	IQ37	IQ47	IQ57	IQ67	IQ77	IQ87	IQ97	+58	
+57	GQ06	GQ16	GQ26	GQ36	GQ46	GQ56	GQ66	GQ76	GQ86	GQ96	HQ06	HQ16	HQ26	HQ36	HQ46	HQ56	HQ66	HQ76	HQ86	HQ96	IQ06	IQ16	IQ26	IQ36	IQ46	IQ56	IQ66	IQ76	IQ86	IQ96	+57	
+56	GQ05	GQ15	GQ25	GQ35	GQ45	GQ55	GQ65	GQ75	GQ85	GQ95	HQ05	HQ15	HQ25	HQ35	HQ45	HQ55	HQ65	HQ75	HQ85	HQ95	IQ05	IQ15	IQ25	IQ35	IQ45	IQ55	IQ65	IQ75	IQ85	IQ95	+56	
+55	GQ04	GQ14	GQ24	GQ34	GQ44	GQ54	GQ64	GQ74	GQ84	GQ94	HQ04	HQ14	HQ24	HQ34	HQ44	HQ54	HQ64	HQ74	HQ84	HQ94	IQ04	IQ14	IQ24	IQ34	IQ44	IQ54	IQ64	IQ74	IQ84	IQ94	+55	
+54	GQ03	GQ13	GQ23	GQ33	GQ43	GQ53	GQ63	GQ73	GQ83	GQ93	HQ03	HQ13	HQ23	HQ33	HQ43	HQ53	HQ63	HQ73	HQ83	HQ93	IQ03	IQ13	IQ23	IQ33	IQ43	IQ53	IQ63	IQ73	IQ83	IQ93	+54	
+53	GQ02	GQ12	GQ22	GQ32	GQ42	GQ52	GQ62	GQ72	GQ82	GQ92	HQ02	HQ12	HQ22	HQ32	HQ42	HQ52	HQ62	HQ72	HQ82	HQ92	IQ02	IQ12	IQ22	IQ32	IQ42	IQ52	IQ62	IQ72	IQ82	IQ92	+53	
+52	GQ01	GQ11	GQ21	GQ31	GQ41	GQ51	GQ61	GQ71	GQ81	GQ91	HQ01	HQ11	HQ21	HQ31	HQ41	HQ51	HQ61	HQ71	HQ81	HQ91	IQ01	IQ11	IQ21	IQ31	IQ41	IQ51	IQ61	IQ71	IQ81	IQ91	+52	
+51	GQ00	GQ10	GQ20	GQ30	GQ40	GQ50	GQ60	GQ70	GQ80	GQ90	HQ00	HQ10	HQ20	HQ30	HQ40	HQ50	HQ60	HQ70	HQ80	HQ90	IQ00	IQ10	IQ20	IQ30	IQ40	IQ50	IQ60	IQ70	IQ80	IQ90	+51	
+50	GN09	GN19	GN29	GN39	GN49	GN59	GN69	GN79	GN89	GN99	HN09	HN19	HN29	HN39	HN49	HN59	HN69	HN79	HN89	HN99	IN09	IN19	IN29	IN39	IN49	IN59	IN69	IN79	IN89	IN99	+50	
+49	GN08	GN18	GN28	GN38	GN48	GN58	GN68	GN78	GN88	GN98	HN08	HN18	HN28	HN38	HN48	HN58	HN68	HN78	HN88	HN98	IN08	IN18	IN28	IN38	IN48	IN58	IN68	IN78	IN88	IN98	+49	
+48	GN07	GN17	GN27	GN37	GN47	GN57	GN67	GN77	GN87	GN97	HN07	HN17	HN27	HN37	HN47	HN57	HN67	HN77	HN87	HN97	IN07	IN17	IN27	IN37	IN47	IN57	IN67	IN77	IN87	IN97	+48	
+47	GN06	GN16	GN26	GN36	GN46	GN56	GN66	GN76	GN86	GN96	HN06	HN16	HN26	HN36	HN46	HN56	HN66	HN76	HN86	HN96	IN06	IN16	IN26	IN36	IN46	IN56	IN66	IN76	IN86	IN96	+47	
+46	GN05	GN15	GN25	GN35	GN45	GN55	GN65	GN75	GN85	GN95	HN05	HN15	HN25	HN35	HN45	HN55	HN65	HN75	HN85	HN95	IN05	IN15	IN25	IN35	IN45	IN55	IN65	IN75	IN85	IN95	+46	
+45	GN04	GN14	GN24	GN34	GN44	GN54	GN64	GN74	GN84	GN94	HN04	HN14	HN24	HN34	HN44	HN54	HN64	HN74	HN84	HN94	IN04	IN14	IN24	IN34	IN44	IN54	IN64	IN74	IN84	IN94	+45	
+44	GN03	GN13	GN23	GN33	GN43	GN53	GN63	GN73	GN83	GN93	HN03	HN13	HN23	HN33	HN43																	



	+0	+2	+4	+6	+8	+10	+12	+14	+16	+18	+20	+22	+24	+26	+28	+30	+32	+34	+36	+38	+40	+42	+44	+46	+48	+50	+52	+54	+56	+58	+60	
-30	JF09	JF19	JF29	JF39	JF49	JF59	JF69	JF79	JF89	JF99	KF09	KF19	KF29	KF39	KF49	KF59	KF69	KF79	KF89	KF99	LF09	LF19	LF29	LF39	LF49	LF59	LF69	LF79	LF89	LF99	-30	
-31	JF08	JF18	JF28	JF38	JF48	JF58	JF68	JF78	JF88	JF98	KF08	KF18	KF28	KF38	KF48	KF58	KF68	KF78	KF88	KF98	LF08	LF18	LF28	LF38	LF48	LF58	LF68	LF78	LF88	LF98	-31	
-32	JF07	JF17	JF27	JF37	JF47	JF57	JF67	JF77	JF87	JF97	KF07	KF17	KF27	KF37	KF47	KF57	KF67	KF77	KF87	KF97	LF07	LF17	LF27	LF37	LF47	LF57	LF67	LF77	LF87	LF97	-32	
-33	JF06	JF16	JF26	JF36	JF46	JF56	JF66	JF76	JF86	JF96	KF06	KF16	KF26	KF36	KF46	KF56	KF66	KF76	KF86	KF96	LF06	LF16	LF26	LF36	LF46	LF56	LF66	LF76	LF86	LF96	-33	
-34	JF05	JF15	JF25	JF35	JF45	JF55	JF65	JF75	JF85	JF95	KF05	KF15	KF25	KF35	KF45	KF55	KF65	KF75	KF85	KF95	LF05	LF15	LF25	LF35	LF45	LF55	LF65	LF75	LF85	LF95	-34	
-35	JF04	JF14	JF24	JF34	JF44	JF54	JF64	JF74	JF84	JF94	KF04	KF14	KF24	KF34	KF44	KF54	KF64	KF74	KF84	KF94	LF04	LF14	LF24	LF34	LF44	LF54	LF64	LF74	LF84	LF94	-35	
-36	JF03	JF13	JF23	JF33	JF43	JF53	JF63	JF73	JF83	JF93	KF03	KF13	KF23	KF33	KF43	KF53	KF63	KF73	KF83	KF93	LF03	LF13	LF23	LF33	LF43	LF53	LF63	LF73	LF83	LF93	-36	
-37	JF02	JF12	JF22	JF32	JF42	JF52	JF62	JF72	JF82	JF92	KF02	KF12	KF22	KF32	KF42	KF52	KF62	KF72	KF82	KF92	LF02	LF12	LF22	LF32	LF42	LF52	LF62	LF72	LF82	LF92	-37	
-38	JF01	JF11	JF21	JF31	JF41	JF51	JF61	JF71	JF81	JF91	KF01	KF11	KF21	KF31	KF41	KF51	KF61	KF71	KF81	KF91	LF01	LF11	LF21	LF31	LF41	LF51	LF61	LF71	LF81	LF91	-38	
-39	JF00	JF10	JF20	JF30	JF40	JF50	JF60	JF70	JF80	JF90	KF00	KF10	KF20	KF30	KF40	KF50	KF60	KF70	KF80	KF90	LF00	LF10	LF20	LF30	LF40	LF50	LF60	LF70	LF80	LF90	-39	
-40	JE09	JE19	JE29	JE39	JE49	JE59	JE69	JE79	JE89	JE99	KE09	KE19	KE29	KE39	KE49	KE59	KE69	KE79	KE89	KE99	LE09	LE19	LE29	LE39	LE49	LE59	LE69	LE79	LE89	LE99	-40	
-41	JE08	JE18	JE28	JE38	JE48	JE58	JE68	JE78	JE88	JE98	KE08	KE18	KE28	KE38	KE48	KE58	KE68	KE78	KE88	KE98	LE08	LE18	LE28	LE38	LE48	LE58	LE68	LE78	LE88	LE98	-41	
-42	JE07	JE17	JE27	JE37	JE47	JE57	JE67	JE77	JE87	JE97	KE07	KE17	KE27	KE37	KE47	KE57	KE67	KE77	KE87	KE97	LE07	LE17	LE27	LE37	LE47	LE57	LE67	LE77	LE87	LE97	-42	
-43	JE06	JE16	JE26	JE36	JE46	JE56	JE66	JE76	JE86	JE96	KE06	KE16	KE26	KE36	KE46	KE56	KE66	KE76	KE86	KE96	LE06	LE16	LE26	LE36	LE46	LE56	LE66	LE76	LE86	LE96	-43	
-44	JE05	JE15	JE25	JE35	JE45	JE55	JE65	JE75	JE85	JE95	KE05	KE15	KE25	KE35	KE45	KE55	KE65	KE75	KE85	KE95	LE05	LE15	LE25	LE35	LE45	LE55	LE65	LE75	LE85	LE95	-44	
-45	JE04	JE14	JE24	JE34	JE44	JE54	JE64	JE74	JE84	JE94	KE04	KE14	KE24	KE34	KE44	KE54	KE64	KE74	KE84	KE94	LE04	LE14	LE24	LE34	LE44	LE54	LE64	LE74	LE84	LE94	-45	
-46	JE03	JE13	JE23	JE33	JE43	JE53	JE63	JE73	JE83	JE93	KE03	KE13	KE23	KE33	KE43	KE53	KE63	KE73	KE83	KE93	LE03	LE13	LE23	LE33	LE43	LE53	LE63	LE73	LE83	LE93	-46	
-47	JE02	JE12	JE22	JE32	JE42	JE52	JE62	JE72	JE82	JE92	KE02	KE12	KE22	KE32	KE42	KE52	KE62	KE72	KE82	KE92	LE02	LE12	LE22	LE32	LE42	LE52	LE62	LE72	LE82	LE92	-47	
-48	JE01	JE11	JE21	JE31	JE41	JE51	JE61	JE71	JE81	JE91	KE01	KE11	KE21	KE31	KE41	KE51	KE61	KE71	KE81	KE91	LE01	LE11	LE21	LE31	LE41	LE51	LE61	LE71	LE81	LE91	-48	
-49	JE00	JE10	JE20	JE30	JE40	JE50	JE60	JE70	JE80	JE90	KE00	KE10	KE20	KE30	KE40	KE50	KE60	KE70	KE80	KE90	LE00	LE10	LE20	LE30	LE40	LE50	LE60	LE70	LE80	LE90	-49	
-50	JD09	JD19	JD29	JD39	JD49	JD59	JD69	JD79	JD89	JD99	KD09	KD19	KD29	KD39	KD49	KD59	KD69	KD79	KD89	KD99	LD09	LD19	LD29	LD39	LD49	LD59	LD69	LD79	LD89	LD99	-50	
-51	JD08	JD18	JD28	JD38	JD48	JD58	JD68	JD78	JD88	JD98	KD08	KD18	KD28	KD38	KD48	KD58	KD68	KD78	KD88	KD98	LD08	LD18	LD28	LD38	LD48	LD58	LD68	LD78	LD88	LD98	-51	
-52	JD07	JD17	JD27	JD37	JD47	JD57	JD67	JD77	JD87	JD97	KD07	KD17	KD27	KD37	KD47	KD57	KD67	KD77	KD87	KD97	LD07	LD17	LD27	LD37	LD47	LD57	LD67	LD77	LD87	LD97	-52	
-53	JD06	JD16	JD26	JD36	JD46	JD56	JD66	JD76	JD86	JD96	KD06	KD16	KD26	KD36	KD46	KD56	KD66	KD76	KD86	KD96	LD06	LD16	LD26	LD36	LD46	LD56	LD66	LD76	LD86	LD96	-53	
-54	JD05	JD15	JD25	JD35	JD45	JD55	JD65	JD75	JD85	JD95	KD05	KD15	KD25	KD35	KD45	KD55	KD65	KD75	KD85	KD95	LD05	LD15	LD25	LD35	LD45	LD55	LD65	LD75	LD85	LD95	-54	
-55	JD04	JD14	JD24	JD34	JD44	JD54	JD64	JD74	JD84	JD94	KD04	KD14	KD24	KD34	KD44	KD54	KD64	KD74	KD84	KD94	LD04	LD14	LD24	LD34	LD44	LD54	LD64	LD74	LD84	LD94	-55	
-56	JD03	JD13	JD23	JD33	JD43	JD53	JD63	JD73	JD83	JD93	KD03	KD13	KD23	KD33	KD43	KD53	KD63	KD73	KD83	KD93	LD03	LD13	LD23	LD33	LD43	LD53	LD63	LD73	LD83	LD93	-56	
-57	JD02	JD12	JD22	JD32	JD42	JD52	JD62	JD72	JD82	JD92	KD02	KD12	KD22	KD32	KD42	KD52	KD62	KD72	KD82	KD92	LD02	LD12	LD22	LD32	LD42	LD52	LD62	LD72	LD82	LD92	-57	
-58	JD01	JD11	JD21	JD31	JD41	JD51	JD61	JD71	JD81	JD91	KD01	KD11	KD21	KD31	KD41	KD51	KD61	KD71	KD81	KD91	LD01	LD11	LD21	LD31	LD41	LD51	LD61	LD71	LD81	LD91	-58	
-59	JD00	JD10	JD20	JD30	JD40	JD50	JD60	JD70	JD80	JD90	KD00	KD10	KD20	KD30	KD40	KD50	KD60	KD70	KD80	KD90	LD00	LD10	LD20	LD30	LD40	LD50	LD60	LD70	LD80	LD90	-59	
-60	JC09	JC19	JC29	JC39	JC49	JC59	JC69	JC79	JC89	JC99	KC09	KC19	KC29	KC39	KC49	KC59	KC69	KC79	KC89	KC99	LC09	LC19	LC29	LC39	LC49	LC59	LC69	LC79	LC89	LC99	-60	
-61	JC08	JC18	JC28	JC38	JC48	JC58	JC68	JC78	JC88	JC98	KC08	KC18	KC28	KC38	KC48	KC58	KC68	KC78	KC88	KC98	LC08	LC18	LC28	LC38	LC48	LC58	LC68	LC78	LC88	LC98	-61	
-62	JC07	JC17	JC27	JC37	JC47	JC57	JC67	JC77	JC87	JC97	KC07	KC17	KC27	KC37	KC47	KC57	KC67	KC77	KC87	KC97	LC07	LC17	LC27	LC37	LC47	LC57	LC67	LC77	LC87	LC97	-62	
-63	JC06	JC16	JC26	JC36	JC46	JC56	JC66	JC76	JC86	JC96	KC06	KC16	KC26	KC36	KC46	KC56	KC66	KC76	KC86	KC96	LC06	LC16	LC26	LC36	LC46	LC56	LC66	LC76	LC86	LC96	-63	
-64	JC05	JC15	JC25	JC35	JC45	JC55	JC65	JC75	JC85	JC95	KC05	KC15	KC25	KC35	KC45	KC55	KC65	KC75	KC85	KC95	LC05	LC15	LC25	LC35	LC45	LC55	LC65	LC75	LC85	LC95	-64	
-65	JC04	JC14	JC24	JC34	JC44	JC54	JC64	JC74	JC84	JC94	KC04	KC14	KC24	KC34	KC44	KC54	KC64	KC74	KC84	KC94	LC04	LC14	LC24	LC34	LC44	LC54	LC64	LC74	LC84	LC94	-65	
-66	JC03	JC13	JC23	JC33	JC43	JC53	JC63	JC73	JC83	JC93	KC03	KC13	KC23	KC33	KC43	KC53	KC63	KC73	KC83	KC93	LC03	LC13	LC23	LC33	LC43	LC53	LC63	LC73	LC83	LC93	-66	
-67	JC02	JC12	JC22	JC32	JC42	JC52	JC62	JC72	JC82	JC92	KC02	KC12	KC22	KC32	KC42	KC52	KC62	KC72	KC82	KC92	LC02	LC12	LC22	LC32	LC42	LC52	LC62	LC72	LC82	LC92	-67	
-68	JC01	JC11	JC21	JC31	JC41	JC51	JC61	JC71	JC81	JC91	KC01	KC11	KC21	KC31	KC41	KC51	KC61	KC71	KC81	KC91	LC01	LC11	LC21	LC31	LC41	LC51	LC61	LC71	LC81	LC91	-68	
-69	JC00	JC10	JC20	JC30	JC40	JC50	JC60	JC70	JC80	JC90	KC00	KC10	KC20	KC30	KC40	KC50	KC60	KC70	KC80	KC90	LC00	LC10	LC20	LC30	LC40	LC50	LC60	LC70	LC80	LC90	-69	
-70	JB09	JB19	JB29	JB39	JB49	JB59	JB69	JB79	JB89	JB99	KB09	KB19	KB29	KB39	KB49	KB59	KB69	KB79	KB89	KB99	LB09	LB19	LB29	LB39	LB49	LB59	LB69	LB79	LB89	LB99	-70	
-71	JB08	JB18	JB28	JB38	JB48	JB58	JB68	JB78	JB88	JB98	KB08	KB18	KB28	KB38	KB48	KB58	KB68	KB78	KB88	KB98	LB08	LB18	LB28	LB38	LB48	LB58	LB68	LB78	LB88	LB98	-71	
-72	JB07	JB17	JB27	JB37	JB47	JB57	JB67	JB77	JB87	JB97	KB07	KB17	KB27	KB37	KB47	KB57	KB67	KB77	KB87	KB97	LB07	LB17	LB27	LB37	LB47	LB57	LB67	LB77	LB87	LB97	-72	
-73	JB06	JB16	JB26	JB36	JB46	JB56	JB66	JB76	JB86	JB96	KB06	KB16	KB26	KB36	KB46	KB56	KB66	KB76	KB86	KB96	LB06	LB16	LB26	LB36	LB46	LB56	LB66	LB76	LB86	LB96	-73	
-74	JB05	JB15	JB25	JB35	JB45	JB55	JB65	JB75	JB85	JB95	KB05	KB15	KB25	KB35	KB45	KB55	KB65	KB75	KB85	KB95	LB05	LB15	LB25	LB35	LB45	LB55	LB65	LB75	LB85	LB95	-74	
-75	JB04	JB14	JB24	JB34	JB44	JB54	JB64	JB74	JB84	JB94	KB04	KB14	KB24	KB34	KB44	KB54	KB64	KB74	KB84	KB94	LB04	LB14	LB24	LB34	LB44	LB54	LB64	LB74	LB84	LB94	-75	
-76	JB03	JB13	JB23	JB33	JB43	JB53	JB63	JB73	JB83	JB93	KB03	KB13	KB23	KB33	KB43	KB53	KB63	KB73	KB83	KB93	LB03	LB13	LB23	LB33	LB43	LB53						







	+0	+2	+4	+6	+8	+10	+12	+14	+16	+18	+20	+22	+24	+26	+28	+30	+32	+34	+36	+38	+40	+42	+44	+46	+48	+50	+52	+54	+56	+58	+60
+90	JR09	JR19	JR29	JR39	JR49	JR59	JR69	JR79	JR89	JR99	KR09	KR19	KR29	KR39	KR49	KR59	KR69	KR79	KR89	KR99	LR09	LR19	LR29	LR39	LR49	LR59	LR69	LR79	LR89	LR99	+90
+89	JR08	JR18	JR28	JR38	JR48	JR58	JR68	JR78	JR88	JR98	KR08	KR18	KR28	KR38	KR48	KR58	KR68	KR78	KR88	KR98	LR08	LR18	LR28	LR38	LR48	LR58	LR68	LR78	LR88	LR98	+89
+88	JR07	JR17	JR27	JR37	JR47	JR57	JR67	JR77	JR87	JR97	KR07	KR17	KR27	KR37	KR47	KR57	KR67	KR77	KR87	KR97	LR07	LR17	LR27	LR37	LR47	LR57	LR67	LR77	LR87	LR97	+88
+87	JR06	JR16	JR26	JR36	JR46	JR56	JR66	JR76	JR86	JR96	KR06	KR16	KR26	KR36	KR46	KR56	KR66	KR76	KR86	KR96	LR06	LR16	LR26	LR36	LR46	LR56	LR66	LR76	LR86	LR96	+87
+86	JR05	JR15	JR25	JR35	JR45	JR55	JR65	JR75	JR85	JR95	KR05	KR15	KR25	KR35	KR45	KR55	KR65	KR75	KR85	KR95	LR05	LR15	LR25	LR35	LR45	LR55	LR65	LR75	LR85	LR95	+86
+85	JR04	JR14	JR24	JR34	JR44	JR54	JR64	JR74	JR84	JR94	KR04	KR14	KR24	KR34	KR44	KR54	KR64	KR74	KR84	KR94	LR04	LR14	LR24	LR34	LR44	LR54	LR64	LR74	LR84	LR94	+85
+84	JR03	JR13	JR23	JR33	JR43	JR53	JR63	JR73	JR83	JR93	KR03	KR13	KR23	KR33	KR43	KR53	KR63	KR73	KR83	KR93	LR03	LR13	LR23	LR33	LR43	LR53	LR63	LR73	LR83	LR93	+84
+83	JR02	JR12	JR22	JR32	JR42	JR52	JR62	JR72	JR82	JR92	KR02	KR12	KR22	KR32	KR42	KR52	KR62	KR72	KR82	KR92	LR02	LR12	LR22	LR32	LR42	LR52	LR62	LR72	LR82	LR92	+83
+82	JR01	JR11	JR21	JR31	JR41	JR51	JR61	JR71	JR81	JR91	KR01	KR11	KR21	KR31	KR41	KR51	KR61	KR71	KR81	KR91	LR01	LR11	LR21	LR31	LR41	LR51	LR61	LR71	LR81	LR91	+82
+81	JR00	JR10	JR20	JR30	JR40	JR50	JR60	JR70	JR80	JR90	KR00	KR10	KR20	KR30	KR40	KR50	KR60	KR70	KR80	KR90	LR00	LR10	LR20	LR30	LR40	LR50	LR60	LR70	LR80	LR90	+81
+80	JQ09	JQ19	JQ29	JQ39	JQ49	JQ59	JQ69	JQ79	JQ89	JQ99	KQ09	KQ19	KQ29	KQ39	KQ49	KQ59	KQ69	KQ79	KQ89	KQ99	LQ09	LQ19	LQ29	LQ39	LQ49	LQ59	LQ69	LQ79	LQ89	LQ99	+80
+79	JQ08	JQ18	JQ28	JQ38	JQ48	JQ58	JQ68	JQ78	JQ88	JQ98	KQ08	KQ18	KQ28	KQ38	KQ48	KQ58	KQ68	KQ78	KQ88	KQ98	LQ08	LQ18	LQ28	LQ38	LQ48	LQ58	LQ68	LQ78	LQ88	LQ98	+79
+78	JQ07	JQ17	JQ27	JQ37	JQ47	JQ57	JQ67	JQ77	JQ87	JQ97	KQ07	KQ17	KQ27	KQ37	KQ47	KQ57	KQ67	KQ77	KQ87	KQ97	LQ07	LQ17	LQ27	LQ37	LQ47	LQ57	LQ67	LQ77	LQ87	LQ97	+78
+77	JQ06	JQ16	JQ26	JQ36	JQ46	JQ56	JQ66	JQ76	JQ86	JQ96	KQ06	KQ16	KQ26	KQ36	KQ46	KQ56	KQ66	KQ76	KQ86	KQ96	LQ06	LQ16	LQ26	LQ36	LQ46	LQ56	LQ66	LQ76	LQ86	LQ96	+77
+76	JQ05	JQ15	JQ25	JQ35	JQ45	JQ55	JQ65	JQ75	JQ85	JQ95	KQ05	KQ15	KQ25	KQ35	KQ45	KQ55	KQ65	KQ75	KQ85	KQ95	LQ05	LQ15	LQ25	LQ35	LQ45	LQ55	LQ65	LQ75	LQ85	LQ95	+76
+75	JQ04	JQ14	JQ24	JQ34	JQ44	JQ54	JQ64	JQ74	JQ84	JQ94	KQ04	KQ14	KQ24	KQ34	KQ44	KQ54	KQ64	KQ74	KQ84	KQ94	LQ04	LQ14	LQ24	LQ34	LQ44	LQ54	LQ64	LQ74	LQ84	LQ94	+75
+74	JQ03	JQ13	JQ23	JQ33	JQ43	JQ53	JQ63	JQ73	JQ83	JQ93	KQ03	KQ13	KQ23	KQ33	KQ43	KQ53	KQ63	KQ73	KQ83	KQ93	LQ03	LQ13	LQ23	LQ33	LQ43	LQ53	LQ63	LQ73	LQ83	LQ93	+74
+73	JQ02	JQ12	JQ22	JQ32	JQ42	JQ52	JQ62	JQ72	JQ82	JQ92	KQ02	KQ12	KQ22	KQ32	KQ42	KQ52	KQ62	KQ72	KQ82	KQ92	LQ02	LQ12	LQ22	LQ32	LQ42	LQ52	LQ62	LQ72	LQ82	LQ92	+73
+72	JQ01	JQ11	JQ21	JQ31	JQ41	JQ51	JQ61	JQ71	JQ81	JQ91	KQ01	KQ11	KQ21	KQ31	KQ41	KQ51	KQ61	KQ71	KQ81	KQ91	LQ01	LQ11	LQ21	LQ31	LQ41	LQ51	LQ61	LQ71	LQ81	LQ91	+72
+71	JQ00	JQ10	JQ20	JQ30	JQ40	JQ50	JQ60	JQ70	JQ80	JQ90	KQ00	KQ10	KQ20	KQ30	KQ40	KQ50	KQ60	KQ70	KQ80	KQ90	LQ00	LQ10	LQ20	LQ30	LQ40	LQ50	LQ60	LQ70	LQ80	LQ90	+71
+69	JP09	JP19	JP29	JP39	JP49	JP59	JP69	JP79	JP89	JP99	KP09	KP19	KP29	KP39	KP49	KP59	KP69	KP79	KP89	KP99	LP09	LP19	LP29	LP39	LP49	LP59	LP69	LP79	LP89	LP99	+69
+68	JP08	JP18	JP28	JP38	JP48	JP58	JP68	JP78	JP88	JP98	KP08	KP18	KP28	KP38	KP48	KP58	KP68	KP78	KP88	KP98	LP08	LP18	LP28	LP38	LP48	LP58	LP68	LP78	LP88	LP98	+68
+67	JP07	JP17	JP27	JP37	JP47	JP57	JP67	JP77	JP87	JP97	KP07	KP17	KP27	KP37	KP47	KP57	KP67	KP77	KP87	KP97	LP07	LP17	LP27	LP37	LP47	LP57	LP67	LP77	LP87	LP97	+67
+66	JP06	JP16	JP26	JP36	JP46	JP56	JP66	JP76	JP86	JP96	KP06	KP16	KP26	KP36	KP46	KP56	KP66	KP76	KP86	KP96	LP06	LP16	LP26	LP36	LP46	LP56	LP66	LP76	LP86	LP96	+66
+65	JP05	JP15	JP25	JP35	JP45	JP55	JP65	JP75	JP85	JP95	KP05	KP15	KP25	KP35	KP45	KP55	KP65	KP75	KP85	KP95	LP05	LP15	LP25	LP35	LP45	LP55	LP65	LP75	LP85	LP95	+65
+64	JP04	JP14	JP24	JP34	JP44	JP54	JP64	JP74	JP84	JP94	KP04	KP14	KP24	KP34	KP44	KP54	KP64	KP74	KP84	KP94	LP04	LP14	LP24	LP34	LP44	LP54	LP64	LP74	LP84	LP94	+64
+63	JP03	JP13	JP23	JP33	JP43	JP53	JP63	JP73	JP83	JP93	KP03	KP13	KP23	KP33	KP43	KP53	KP63	KP73	KP83	KP93	LP03	LP13	LP23	LP33	LP43	LP53	LP63	LP73	LP83	LP93	+63
+62	JP02	JP12	JP22	JP32	JP42	JP52	JP62	JP72	JP82	JP92	KP02	KP12	KP22	KP32	KP42	KP52	KP62	KP72	KP82	KP92	LP02	LP12	LP22	LP32	LP42	LP52	LP62	LP72	LP82	LP92	+62
+61	JP01	JP11	JP21	JP31	JP41	JP51	JP61	JP71	JP81	JP91	KP01	KP11	KP21	KP31	KP41	KP51	KP61	KP71	KP81	KP91	LP01	LP11	LP21	LP31	LP41	LP51	LP61	LP71	LP81	LP91	+61
+60	JP00	JP10	JP20	JP30	JP40	JP50	JP60	JP70	JP80	JP90	KP00	KP10	KP20	KP30	KP40	KP50	KP60	KP70	KP80	KP90	LP00	LP10	LP20	LP30	LP40	LP50	LP60	LP70	LP80	LP90	+60
+59	JQ09	JQ19	JQ29	JQ39	JQ49	JQ59	JQ69	JQ79	JQ89	JQ99	KQ09	KQ19	KQ29	KQ39	KQ49	KQ59	KQ69	KQ79	KQ89	KQ99	LQ09	LQ19	LQ29	LQ39	LQ49	LQ59	LQ69	LQ79	LQ89	LQ99	+59
+58	JQ08	JQ18	JQ28	JQ38	JQ48	JQ58	JQ68	JQ78	JQ88	JQ98	KQ08	KQ18	KQ28	KQ38	KQ48	KQ58	KQ68	KQ78	KQ88	KQ98	LQ08	LQ18	LQ28	LQ38	LQ48	LQ58	LQ68	LQ78	LQ88	LQ98	+58
+57	JQ07	JQ17	JQ27	JQ37	JQ47	JQ57	JQ67	JQ77	JQ87	JQ97	KQ07	KQ17	KQ27	KQ37	KQ47	KQ57	KQ67	KQ77	KQ87	KQ97	LQ07	LQ17	LQ27	LQ37	LQ47	LQ57	LQ67	LQ77	LQ87	LQ97	+57
+56	JQ06	JQ16	JQ26	JQ36	JQ46	JQ56	JQ66	JQ76	JQ86	JQ96	KQ06	KQ16	KQ26	KQ36	KQ46	KQ56	KQ66	KQ76	KQ86	KQ96	LQ06	LQ16	LQ26	LQ36	LQ46	LQ56	LQ66	LQ76	LQ86	LQ96	+56
+55	JQ05	JQ15	JQ25	JQ35	JQ45	JQ55	JQ65	JQ75	JQ85	JQ95	KQ05	KQ15	KQ25	KQ35	KQ45	KQ55	KQ65	KQ75	KQ85	KQ95	LQ05	LQ15	LQ25	LQ35	LQ45	LQ55	LQ65	LQ75	LQ85	LQ95	+55
+54	JQ04	JQ14	JQ24	JQ34	JQ44	JQ54	JQ64	JQ74	JQ84	JQ94	KQ04	KQ14	KQ24	KQ34	KQ44	KQ54	KQ64	KQ74	KQ84	KQ94	LQ04	LQ14	LQ24	LQ34	LQ44	LQ54	LQ64	LQ74	LQ84	LQ94	+54
+53	JQ03	JQ13	JQ23	JQ33	JQ43	JQ53	JQ63	JQ73	JQ83	JQ93	KQ03	KQ13	KQ23	KQ33	KQ43	KQ53	KQ63	KQ73	KQ83	KQ93	LQ03	LQ13	LQ23	LQ33	LQ43	LQ53	LQ63	LQ73	LQ83	LQ93	+53
+52	JQ02	JQ12	JQ22	JQ32	JQ42	JQ52	JQ62	JQ72	JQ82	JQ92	KQ02	KQ12	KQ22	KQ32	KQ42	KQ52	KQ62	KQ72	KQ82	KQ92	LQ02	LQ12	LQ22	LQ32	LQ42	LQ52	LQ62	LQ72	LQ82	LQ92	+52
+51	JQ01	JQ11	JQ21	JQ31	JQ41	JQ51	JQ61	JQ71	JQ81	JQ91	KQ01	KQ11	KQ21	KQ31	KQ41	KQ51	KQ61	KQ71	KQ81	KQ91	LQ01	LQ11	LQ21	LQ31	LQ41	LQ51	LQ61	LQ71	LQ81	LQ91	+51
+50	JQ00	JQ10	JQ20	JQ30	JQ40	JQ50	JQ60	JQ70	JQ80	JQ90	KQ00	KQ10	KQ20	KQ30	KQ40	KQ50	KQ60	KQ70	KQ80	KQ90	LQ00	LQ10	LQ20	LQ30	LQ40	LQ50	LQ60	LQ70	LQ80	LQ90	+50
+49	JN09	JN19	JN29	JN39	JN49	JN59	JN69	JN79	JN89	JN99	KN09	KN19	KN29	KN39	KN49	KN59	KN69	KN79	KN89	KN99	LN09	LN19	LN29	LN39	LN49	LN59	LN69	LN79	LN89	LN99	+49
+48	JN08	JN18	JN28	JN38	JN48	JN58	JN68	JN78	JN88	JN98	KN08	KN18	KN28	KN38	KN48	KN58	KN68	KN78	KN88	KN98	LN08	LN18	LN28	LN38	LN48	LN58	LN68	LN78	LN88	LN98	+48
+47	JN07	JN17	JN27	JN37	JN47	JN57	JN67	JN77	JN87	JN97	KN07	KN17	KN27	KN37	KN47	KN57	KN67	KN77	KN87	KN97	LN07	LN17	LN27	LN37	LN47	LN57	LN67	LN77	LN87	LN97	+47
+46	JN06	JN16	JN26	JN36	JN46	JN56	JN66	JN76	JN86	JN96	KN06	KN16	KN26	KN36	KN46	KN56	KN66	KN76	KN86	KN96	LN06	LN16	LN26	LN36	LN46	LN56	LN66	LN76	LN86	LN96	+46
+45	JN05	JN15	JN25	JN35	JN45	JN55	JN65	JN75	JN85	JN95	KN05	KN15	KN25	KN35	KN45	KN55	KN65	KN75	KN85	KN95	LN05	LN15	LN25	LN35	LN45	LN55	LN65	LN75	LN85	LN95	+45
+44	JN04	JN14	JN24	JN34	JN44	JN54	JN64	JN74	JN84	JN94	KN04	KN14	KN24	KN34	KN44	KN54	KN64	KN74	KN84	KN94	LN04	LN14	LN24	LN34	LN44	LN54	LN64	LN74	LN84	LN94	+44
+43	JN03	JN13	JN23	JN33	JN43	JN53	JN63	JN73	JN83	JN93	KN03	KN13	KN23	KN33	KN43	KN53	KN63	KN73	KN83	KN93	LN03	LN13	LN23	LN33	LN43	LN53	LN63	LN73	LN83	LN93	+43
+42	JN02	JN12	JN22	JN																											











+60 +62 +64 +66 +68 +70 +72 +74 +76 +78 +80 +82 +84 +86 +88 +90 +92 +94 +96 +98 +100 +102 +104 +106 +108 +110 +112 +114 +116 +118 +120



+120 +122 +124 +126 +128 +130 +132 +134 +136 +138 +140 +142 +144 +146 +148 +150 +152 +154 +156 +158 +160 +162 +164 +166 +168 +170 +172 +174 +176 +178 +180



	+120	+122	+124	+126	+128	+130	+132	+134	+136	+138	+140	+142	+144	+146	+148	+150	+152	+154	+156	+158	+160	+162	+164	+166	+168	+170	+172	+174	+176	+178	+180	
+30	PL19	PL29	PL39	PL49	PL59	PL69	PL79	PL89	PL99	QL09	QL19	QL29	QL39	QL49	QL59	QL69	QL79	QL89	QL99	RL09	RL19	RL29	RL39	RL49	RL59	RL69	RL79	RL89	RL99		+30	
+29	PL18	PL28	PL38	PL48	PL58	PL68	PL78	PL88	PL98	QL08	QL18	QL28	QL38	QL48	QL58	QL68	QL78	QL88	QL98	RL08	RL18	RL28	RL38	RL48	RL58	RL68	RL78	RL88	RL98		+29	
+28	PL17	PL27	PL37	PL47	PL57	PL67	PL77	PL87	PL97	QL07	QL17	QL27	QL37	QL47	QL57	QL67	QL77	QL87	QL97	RL07	RL17	RL27	RL37	RL47	RL57	RL67	RL77	RL87	RL97		+28	
+27	PL16	PL26	PL36	PL46	PL56	PL66	PL76	PL86	PL96	QL06	QL16	QL26	QL36	QL46	QL56	QL66	QL76	QL86	QL96	RL06	RL16	RL26	RL36	RL46	RL56	RL66	RL76	RL86	RL96		+27	
+26	PL15	PL25	PL35	PL45	PL55	PL65	PL75	PL85	PL95	QL05	QL15	QL25	QL35	QL45	QL55	QL65	QL75	QL85	QL95	RL05	RL15	RL25	RL35	RL45	RL55	RL65	RL75	RL85	RL95		+26	
+25	PL14	PL24	PL34	PL44	PL54	PL64	PL74	PL84	PL94	QL04	QL14	QL24	QL34	QL44	QL54	QL64	QL74	QL84	QL94	RL04	RL14	RL24	RL34	RL44	RL54	RL64	RL74	RL84	RL94		+25	
+24	PL13	PL23	PL33	PL43	PL53	PL63	PL73	PL83	PL93	QL03	QL13	QL23	QL33	QL43	QL53	QL63	QL73	QL83	QL93	RL03	RL13	RL23	RL33	RL43	RL53	RL63	RL73	RL83	RL93		+24	
+23	PL12	PL22	PL32	PL42	PL52	PL62	PL72	PL82	PL92	QL02	QL12	QL22	QL32	QL42	QL52	QL62	QL72	QL82	QL92	RL02	RL12	RL22	RL32	RL42	RL52	RL62	RL72	RL82	RL92		+23	
+22	PL11	PL21	PL31	PL41	PL51	PL61	PL71	PL81	PL91	QL01	QL11	QL21	QL31	QL41	QL51	QL61	QL71	QL81	QL91	RL01	RL11	RL21	RL31	RL41	RL51	RL61	RL71	RL81	RL91		+22	
+21	PL10	PL20	PL30	PL40	PL50	PL60	PL70	PL80	PL90	QL00	QL10	QL20	QL30	QL40	QL50	QL60	QL70	QL80	QL90	RL00	RL10	RL20	RL30	RL40	RL50	RL60	RL70	RL80	RL90		+21	
+20	PK19	PK29	PK39	PK49	PK59	PK69	PK79	PK89	PK99	QK09	QK19	QK29	QK39	QK49	QK59	QK69	QK79	QK89	QK99	RK09	RK19	RK29	RK39	RK49	RK59	RK69	RK79	RK89	RK99		+20	
+19	PK18	PK28	PK38	PK48	PK58	PK68	PK78	PK88	PK98	QK08	QK18	QK28	QK38	QK48	QK58	QK68	QK78	QK88	QK98	RK08	RK18	RK28	RK38	RK48	RK58	RK68	RK78	RK88	RK98		+19	
+18	PK17	PK27	PK37	PK47	PK57	PK67	PK77	PK87	PK97	QK07	QK17	QK27	QK37	QK47	QK57	QK67	QK77	QK87	QK97	RK07	RK17	RK27	RK37	RK47	RK57	RK67	RK77	RK87	RK97		+18	
+17	PK16	PK26	PK36	PK46	PK56	PK66	PK76	PK86	PK96	QK06	QK16	QK26	QK36	QK46	QK56	QK66	QK76	QK86	QK96	RK06	RK16	RK26	RK36	RK46	RK56	RK66	RK76	RK86	RK96		+17	
+16	PK15	PK25	PK35	PK45	PK55	PK65	PK75	PK85	PK95	QK05	QK15	QK25	QK35	QK45	QK55	QK65	QK75	QK85	QK95	RK05	RK15	RK25	RK35	RK45	RK55	RK65	RK75	RK85	RK95		+16	
+15	PK14	PK24	PK34	PK44	PK54	PK64	PK74	PK84	PK94	QK04	QK14	QK24	QK34	QK44	QK54	QK64	QK74	QK84	QK94	RK04	RK14	RK24	RK34	RK44	RK54	RK64	RK74	RK84	RK94		+15	
+14	PK13	PK23	PK33	PK43	PK53	PK63	PK73	PK83	PK93	QK03	QK13	QK23	QK33	QK43	QK53	QK63	QK73	QK83	QK93	RK03	RK13	RK23	RK33	RK43	RK53	RK63	RK73	RK83	RK93		+14	
+13	PK12	PK22	PK32	PK42	PK52	PK62	PK72	PK82	PK92	QK02	QK12	QK22	QK32	QK42	QK52	QK62	QK72	QK82	QK92	RK02	RK12	RK22	RK32	RK42	RK52	RK62	RK72	RK82	RK92		+13	
+12	PK11	PK21	PK31	PK41	PK51	PK61	PK71	PK81	PK91	QK01	QK11	QK21	QK31	QK41	QK51	QK61	QK71	QK81	QK91	RK01	RK11	RK21	RK31	RK41	RK51	RK61	RK71	RK81	RK91		+12	
+11	PK10	PK20	PK30	PK40	PK50	PK60	PK70	PK80	PK90	QK00	QK10	QK20	QK30	QK40	QK50	QK60	QK70	QK80	QK90	RK00	RK10	RK20	RK30	RK40	RK50	RK60	RK70	RK80	RK90		+11	
+10	PJ09	PJ19	PJ29	PJ39	PJ49	PJ59	PJ69	PJ79	PJ89	PJ99	QJ09	QJ19	QJ29	QJ39	QJ49	QJ59	QJ69	QJ79	QJ89	QJ99	RJ09	RJ19	RJ29	RJ39	RJ49	RJ59	RJ69	RJ79	RJ89	RJ99		+10
+9	PJ08	PJ18	PJ28	PJ38	PJ48	PJ58	PJ68	PJ78	PJ88	PJ98	QJ08	QJ18	QJ28	QJ38	QJ48	QJ58	QJ68	QJ78	QJ88	QJ98	RJ08	RJ18	RJ28	RJ38	RJ48	RJ58	RJ68	RJ78	RJ88	RJ98		+9
+8	PJ07	PJ17	PJ27	PJ37	PJ47	PJ57	PJ67	PJ77	PJ87	PJ97	QJ07	QJ17	QJ27	QJ37	QJ47	QJ57	QJ67	QJ77	QJ87	QJ97	RJ07	RJ17	RJ27	RJ37	RJ47	RJ57	RJ67	RJ77	RJ87	RJ97		+8
+7	PJ06	PJ16	PJ26	PJ36	PJ46	PJ56	PJ66	PJ76	PJ86	PJ96	QJ06	QJ16	QJ26	QJ36	QJ46	QJ56	QJ66	QJ76	QJ86	QJ96	RJ06	RJ16	RJ26	RJ36	RJ46	RJ56	RJ66	RJ76	RJ86	RJ96		+7
+6	PJ05	PJ15	PJ25	PJ35	PJ45	PJ55	PJ65	PJ75	PJ85	PJ95	QJ05	QJ15	QJ25	QJ35	QJ45	QJ55	QJ65	QJ75	QJ85	QJ95	RJ05	RJ15	RJ25	RJ35	RJ45	RJ55	RJ65	RJ75	RJ85	RJ95		+6
+5	PJ04	PJ14	PJ24	PJ34	PJ44	PJ54	PJ64	PJ74	PJ84	PJ94	QJ04	QJ14	QJ24	QJ34	QJ44	QJ54	QJ64	QJ74	QJ84	QJ94	RJ04	RJ14	RJ24	RJ34	RJ44	RJ54	RJ64	RJ74	RJ84	RJ94		+5
+4	PJ03	PJ13	PJ23	PJ33	PJ43	PJ53	PJ63	PJ73	PJ83	PJ93	QJ03	QJ13	QJ23	QJ33	QJ43	QJ53	QJ63	QJ73	QJ83	QJ93	RJ03	RJ13	RJ23	RJ33	RJ43	RJ53	RJ63	RJ73	RJ83	RJ93		+4
+3	PJ02	PJ12	PJ22	PJ32	PJ42	PJ52	PJ62	PJ72	PJ82	PJ92	QJ02	QJ12	QJ22	QJ32	QJ42	QJ52	QJ62	QJ72	QJ82	QJ92	RJ02	RJ12	RJ22	RJ32	RJ42	RJ52	RJ62	RJ72	RJ82	RJ92		+3
+2	PJ01	PJ11	PJ21	PJ31	PJ41	PJ51	PJ61	PJ71	PJ81	PJ91	QJ01	QJ11	QJ21	QJ31	QJ41	QJ51	QJ61	QJ71	QJ81	QJ91	RJ01	RJ11	RJ21	RJ31	RJ41	RJ51	RJ61	RJ71	RJ81	RJ91		+2
+1	PJ00	PJ10	PJ20	PJ30	PJ40	PJ50	PJ60	PJ70	PJ80	PJ90	QJ00	QJ10	QJ20	QJ30	QJ40	QJ50	QJ60	QJ70	QJ80	QJ90	RJ00	RJ10	RJ20	RJ30	RJ40	RJ50	RJ60	RJ70	RJ80	RJ90		+1
+0	PI09	PI19	PI29	PI39	PI49	PI59	PI69	PI79	PI89	PI99	QI09	QI19	QI29	QI39	QI49	QI59	QI69	QI79	QI89	QI99	RI09	RI19	RI29	RI39	RI49	RI59	RI69	RI79	RI89	RI99		+0
-1	PI08	PI18	PI28	PI38	PI48	PI58	PI68	PI78	PI88	PI98	QI08	QI18	QI28	QI38	QI48	QI58	QI68	QI78	QI88	QI98	RI08	RI18	RI28	RI38	RI48	RI58	RI68	RI78	RI88	RI98		-1
-2	PI07	PI17	PI27	PI37	PI47	PI57	PI67	PI77	PI87	PI97	QI07	QI17	QI27	QI37	QI47	QI57	QI67	QI77	QI87	QI97	RI07	RI17	RI27	RI37	RI47	RI57	RI67	RI77	RI87	RI97		-2
-3	PI06	PI16	PI26	PI36	PI46	PI56	PI66	PI76	PI86	PI96	QI06	QI16	QI26	QI36	QI46	QI56	QI66	QI76	QI86	QI96	RI06	RI16	RI26	RI36	RI46	RI56	RI66	RI76	RI86	RI96		-3
-4	PI05	PI15	PI25	PI35	PI45	PI55	PI65	PI75	PI85	PI95	QI05	QI15	QI25	QI35	QI45	QI55	QI65	QI75	QI85	QI95	RI05	RI15	RI25	RI35	RI45	RI55	RI65	RI75	RI85	RI95		-4
-5	PI04	PI14	PI24	PI34	PI44	PI54	PI64	PI74	PI84	PI94	QI04	QI14	QI24	QI34	QI44	QI54	QI64	QI74	QI84	QI94	RI04	RI14	RI24	RI34	RI44	RI54	RI64	RI74	RI84	RI94		-5
-6	PI03	PI13	PI23	PI33	PI43	PI53	PI63	PI73	PI83	PI93	QI03	QI13	QI23	QI33	QI43	QI53	QI63	QI73	QI83	QI93	RI03	RI13	RI23	RI33	RI43	RI53	RI63	RI73	RI83	RI93		-6
-7	PI02	PI12	PI22	PI32	PI42	PI52	PI62	PI72	PI82	PI92	QI02	QI12	QI22	QI32	QI42	QI52	QI62	QI72	QI82	QI92	RI02	RI12	RI22	RI32	RI42	RI52	RI62	RI72	RI82	RI92		-7
-8	PI01	PI11	PI21	PI31	PI41	PI51	PI61	PI71	PI81	PI91	QI01	QI11	QI21	QI31	QI41	QI51	QI61	QI71	QI81	QI91	RI01	RI11	RI21	RI31	RI41	RI51	RI61	RI71	RI81	RI91		-8
-9	PI00	PI10	PI20	PI30	PI40	PI50	PI60	PI70	PI80	PI90	QI00	QI10	QI20	QI30	QI40	QI50	QI60	QI70	QI80	QI90	RI00	RI10	RI20	RI30	RI40	RI50	RI60	RI70	RI80	RI90		-9
-10	PH09	PH19	PH29	PH39	PH49	PH59	PH69	PH79	PH89	PH99	QH09	QH19	QH29	QH39	QH49	QH59	QH69	QH79	QH89	QH99	RH09	RH19	RH29	RH39	RH49	RH59	RH69	RH79	RH89	RH99		-10
-11	PH08	PH18	PH28	PH38	PH48	PH58	PH68	PH78	PH88	PH98	QH08	QH18	QH28	QH38	QH48	QH58	QH68	QH78	QH88	QH98	RH08	RH18	RH28	RH38	RH48	RH58	RH68	RH78	RH88	RH98		-11
-12	PH07	PH17	PH27	PH37	PH47	PH57	PH67	PH77	PH87	PH97	QH07	QH17	QH27	QH37	QH47	QH57	QH67	QH77	QH87	QH97	RH07	RH17	RH27	RH37	RH47	RH57	RH67	RH77	RH87	RH97		-12
-13	PH06	PH16	PH26	PH36	PH46	PH56	PH66	PH76	PH86	PH96	QH06	QH16	QH26	QH36	QH46	QH56	QH66	QH76	QH86	QH96	RH06	RH16	RH26	RH36	RH46	RH56	RH66	RH76	RH86	RH96		-13
-14	PH05	PH15	PH25	PH35	PH45	PH55	PH65	PH75	PH85	PH95	QH05	QH15	QH25	QH35	QH45	QH55	QH65	QH75	QH85	QH95	RH05	RH15	RH25	RH35	RH45	RH55	RH65	RH75	RH85	RH95		-14
-15	PH04	PH14	PH24	PH34	PH44	PH54	PH64	PH74	PH84	PH94	QH04	QH14	QH24	QH34	QH44	QH54	QH64	QH74	QH84	QH94	RH04	RH14	RH24	RH34	RH44							



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+89	PR08	PR18	PR28	PR38	PR48	PR58	PR68	PR78	PR88	PR98	Q008	Q018	Q028	Q038	Q048	Q058	Q068	Q078	Q088	Q098	Q108	Q118	Q128	Q138	Q148	Q158	Q168	Q178	Q188	Q198							
+88	PR07	PR17	PR27	PR37	PR47	PR57	PR67	PR77	PR87	PR97	Q007	Q017	Q027	Q037	Q047	Q057	Q067	Q077	Q087	Q097	Q107	Q117	Q127	Q137	Q147	Q157	Q167	Q177	Q187	Q197							
+87	PR06	PR16	PR26	PR36	PR46	PR56	PR66	PR76	PR86	PR96	Q006	Q016	Q026	Q036	Q046	Q056	Q066	Q076	Q086	Q096	Q106	Q116	Q126	Q136	Q146	Q156	Q166	Q176	Q186	Q196							
+86	PR05	PR15	PR25	PR35	PR45	PR55	PR65	PR75	PR85	PR95	Q005	Q015	Q025	Q035	Q045	Q055	Q065	Q075	Q085	Q095	Q105	Q115	Q125	Q135	Q145	Q155	Q165	Q175	Q185	Q195							
+85	PR04	PR14	PR24	PR34	PR44	PR54	PR64	PR74	PR84	PR94	Q004	Q014	Q024	Q034	Q044	Q054	Q064	Q074	Q084	Q094	Q104	Q114	Q124	Q134	Q144	Q154	Q164	Q174	Q184	Q194							
+84	PR03	PR13	PR23	PR33	PR43	PR53	PR63	PR73	PR83	PR93	Q003	Q013	Q023	Q033	Q043	Q053	Q063	Q073	Q083	Q093	Q103	Q113	Q123	Q133	Q143	Q153	Q163	Q173	Q183	Q193							
+83	PR02	PR12	PR22	PR32	PR42	PR52	PR62	PR72	PR82	PR92	Q002	Q012	Q022	Q032	Q042	Q052	Q062	Q072	Q082	Q092	Q102	Q112	Q122	Q132	Q142	Q152	Q162	Q172	Q182	Q192							
+82	PR01	PR11	PR21	PR31	PR41	PR51	PR61	PR71	PR81	PR91	Q001	Q011	Q021	Q031	Q041	Q051	Q061	Q071	Q081	Q091	Q101	Q111	Q121	Q131	Q141	Q151	Q161	Q171	Q181	Q191							
+81	PR00	PR10	PR20	PR30	PR40	PR50	PR60	PR70	PR80	PR90	Q000	Q010	Q020	Q030	Q040	Q050	Q060	Q070	Q080	Q090	Q100	Q110	Q120	Q130	Q140	Q150	Q160	Q170	Q180	Q190							
+80	Q009	Q019	Q029	Q039	Q049	Q059	Q069	Q079	Q089	Q099	Q109	Q119	Q129	Q139	Q149	Q159	Q169	Q179	Q189	Q199	Q209	Q219	Q229	Q239	Q249	Q259	Q269	Q279	Q289	Q299							
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+78	Q007	Q017	Q027	Q037	Q047	Q057	Q067	Q077	Q087	Q097	Q107	Q117	Q127	Q137	Q147	Q157	Q167	Q077	Q087	Q097	Q107	Q117	Q127	Q137	Q147	Q157	Q167	Q177	Q187	Q197							
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+74	Q003	Q013	Q023	Q033	Q043	Q053	Q063	Q073	Q083	Q093	Q103	Q113	Q123	Q133	Q143	Q153	Q163	Q033	Q043	Q053	Q063	Q073	Q083	Q093	Q103	Q113	Q123	Q133	Q143	Q153	Q163	Q173	Q183	Q193			
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+70	PN09	PN19	PN29	PN39	PN49	PN59	PN69	PN79	PN89	PN99	Q009	Q019	Q029	Q039	Q049	Q059	Q069	Q079	Q089	Q099	Q109	Q119	Q129	Q139	Q149	Q159	Q169	Q179	Q189	Q199							
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+46	PN05	PN15	PN25	PN35	PN45	PN55	PN65	PN75	PN85	PN95	Q005	Q015																									



# Index

This list gives name, page and, if more than half of the geographical unit is contained within a field or a square, the field or the square. If the geographical unit is covered by two or several pages, only one page is given.

This means that if you have worked a station for example in Luxembourg and this list gives square JN39, you only know that most of Luxembourg is within JN39, not that the station really was in that square. In fact Luxembourg also covers the squares JN29, JO20 and JO30.

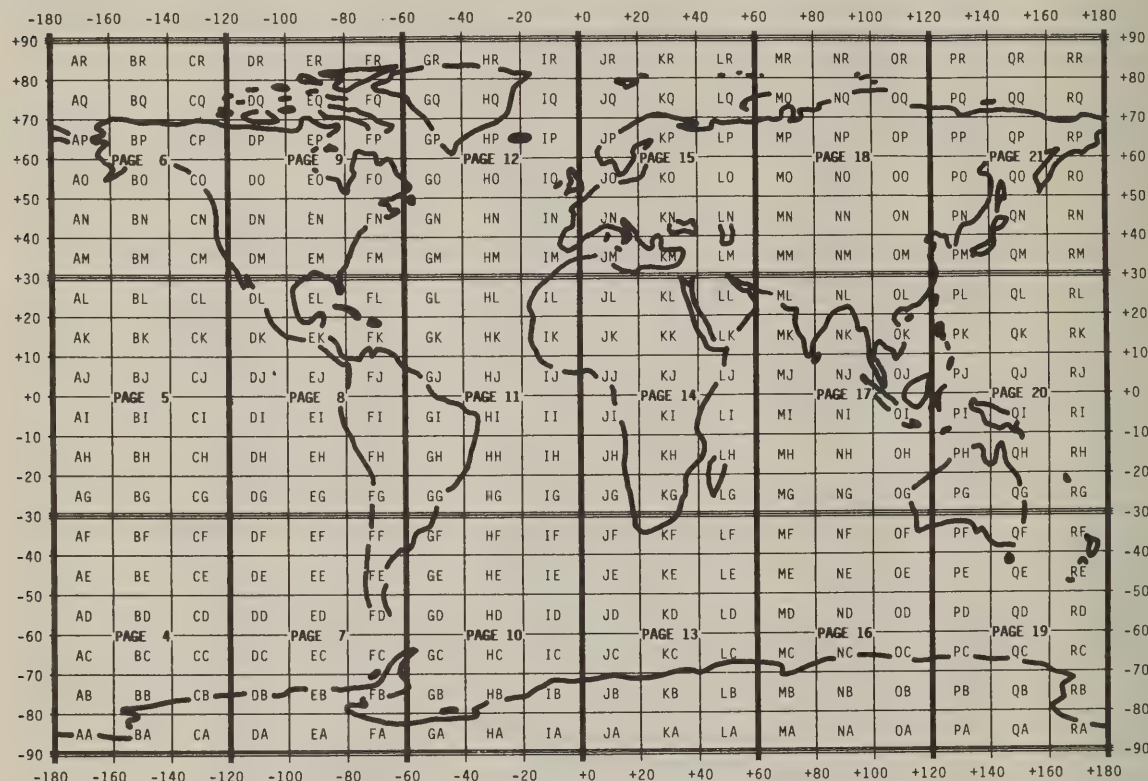
Abidjan	11	IJ75	Boograd	15	KN04	Cruzen Island	4	BB95	Gough Island	10	IE59
Accra	14	LL74	Berlinga, Ostrov	21	RO35	Cuba	8	FL	Graciosa	12	HM59
Accres	12	IJ95	Berkner Island	10	GB50	Culpepper, Isla	8	EJ41	Gran Canaria	12	IL27
Addis Ababa	14	KJ99	Berlin	15	JO62	Curacao	8	FK52	Grand Bahama	8	FL06
Adelaide	19	PF95	Bermuda	9	FM72	Curtis Island	8	AF09	Great Abaco	8	FL16
Adelaide Island	7	FC52	Beveridge Reef	5	AH60	Cyprus	15	KM	Greece	15	KM
Aden	14	LK22	Bayoneisu Retsugan	21	PM91	Czechoslovakia	15	JN	Greenland	8	FK29
Afganistan	18	MM	Beyrouth	15	KM73	D.D.R.	15	JO	Grenada	8	FK92
Afognak Island	16	BO38	Bhutan	17	LN57	Dacca	17	LN53	Gronland	12	
Agalega Islands	14	LH89	Bikini	20	KK21	Dakar	11	IK14	Gruzinskaya S.S.R.	15	LN
Agattu Island	21	RO62	Bioko	14	JJ43	Damascus	15	KM83	Guadalcanal Island	20	RI00
Aghenammaa	15	KP00	Bissau	11	IK21	Danmark	15	JO	Guadeloupe	8	FK96
Altutaki	5	BH01	Bjornoya	15	JO94	Dar Es Salaam	14	KI93	Guam	20	QK23
Alabama	9	EM	Boa Vista	11	HK86	Darwin	20	PH57	Guangzhou	17	OL63
Aland	15	KP00	Bogota	8	FJ24	Dawnah, Ad	14	LS55	Guantanamo Bay	8	FK29
Alaska	6	BP	Boi Shevik, Ostrov	18	OO	Delaware	9	FM	Guatemala (City)	8	EK44
Albania	19	BN	Bolivia	8	FH	Delhi	17	ML88	Guatemala (City)	8	EK44
Alberta	9	DO	Bombay	17	MK68	Denmark	15	JO	Guatemala (City)	8	EK44
Aldabra Islands	14	LI30	Bonaire	8	FK52	Desecheo Island	8	FK68	Guernsey	12	IN89
Alejandro Selkirk, I.	7	EF96	Bonn	15	JO30	Deutsche Demokr. Rep.	15	JO	Guinea-Bissau	11	IK
Aleksandra Ostrova	15	LR30	Borden Island	9	DQ	Deutschland, Bundesr.	15	JO	Guinea	11	IK
Aleutian Islands	6	AO	Borneo	17	JO	Devon Island	9	EQ	Guyana	11	GJ
Alexander Archipelago	6	CO	Botswana	14	KG	Diego Ramirez, Islas	7	FK53	Habana, La	8	EL83
Alexander Island	7	FB	Bougainville Island	20	QJ73	Disko	12	GP39	Hachijo-Jima	21	PM33
Algeria	14	JM16	Bounty Islands	19	RE92	Djizair, El	15	JM16	Hainan Dao	17	OK
Algeria	14		Bouvet Oy	13	JD15	Djibouti	14	LK11	Haiti	8	FK38
Alma Ata	18	MN83	Boyne, Iles	16	MD49	Dodecanese	15	KM	Halmahera	20	PJ
American Samoa	5	AH45	Brasil	11		Dominica	8	FK95	Hanoi	17	OL21
Amman	15	KM71	Brasilia	11	GH64	Dominican Republic	8	FK	Havre Rock	4	AF08
Amsterdam	15	JO22	Bratsk	18	OO06	Ducie Island	15	CO75	Hawaii	5	KB29
Amsterdam, Ile	16	MF82	Brava	11	HK74	Earl of Gloucester, Is.	5	GG89	Hawaiian Islands	5	BL
Amund Ringnes Island	9	EQ	Brazil	14	JI75	Dushanbe	18	MM48	Haymet Rocks	18	MD66
Anchorage	17	KN51	Brisbane	20	QG62	Easter Island	8	DG52	Heard Island	16	MD66
Andaman Islands	17	NK	British Columbia	6	CO	Edgeoya	15	KQ17	Hellas	15	KM
Andorra	15	JN02	Brunei	17	OU74	Egypt	14	KL	Helinski	15	KP20
Angkor	8	FL14	Brussel	15	JO30	El Salvador	8	EK53	Helvetia	15	JN
Angmagssalik	12	HP15	Bruxelles	15	JO30	Eleutera	8	FL15	Henderson Island	5	CG55
Anguilla	8	FK88	Buckley Island	19	RC13	Elizabeth Reef	20	QG90	Hervey Islands	5	BH00
Ankara	15	KM69	Bucuresti	15	KN34	El Estero, Ringnes Island	9	DQ	Hierro	11	OL07
Anobon	15	JI28	Budapest	15	JN97	Ellesmere Island	9	QF08	Hiva Oa	5	CI00
Antananarivo	14	LH31	Buenos Aires	10	GF06	England	12	IO	Ho Chi Minh	17	OK30
Antarctica	4		Bujumbura	14	KI46	Ecuador	8	FI	Hokkaido	20	QN
Anticosti Island	9	FN89	Bulgaria	15	KN	Equatorial Guinea	14	JM51	Honduras	8	EK
Antigua	8	FK97	Burma	17	NL	Ernest Legouve Reef	4	BF44	Hong Kong	17	OL72
Antiope Reef	5	AH51	Burundi	14	KI	Espanola, Isla	8	EI58	Honiara	20	QI90
Antipodes Islands	19	RE90	Cabinda	14	JI64	Esperance Rock, L	4	AF08	Honolulu	5	BL11
Aoga-Shima	21	PM92	Cabo Verde, Ilhas Do	11	HK	Estad, Ile De L'	13	LE63	Hopen	15	KQ26
Apotres, Iles Des	13	LE54	Calcos Islands	8	FL41	Estados, Isla De Los	7	FD75	Howland Island	5	AJ10
Argentina	9	DM	Cairo	15	KM50	Estonia	15	KO	Huail Island	5	AJ35
Arizona	9	DM	Calcutta	17	NL42	Estonkaya S.S.R.	15	KO	Hungary	12	IP
Arkansas	9	EM	California	9		Ethiopia	14		Idaho	9	DN
Arkhangel 'Sk	15	LP04	Cameroun	14	JJ	Eua	5	AG28	Illinois	9	EN
Armenia	15	LN	Campbell Island	19	RD47	Europa, Ile	14	LG07	Inaccessible Island	10	IF32
Armynskaya S.S.R.	15	LN	Canada	9	IL	Eura	5	AG28	India	17	
Aruba	8	FK52	Canarias, Islas	11	IL	F.R.G.	15	JO	Indiana	9	EM
Ascension	11	IJ2	Canary Islands	11	IL	Faeroerne	12	IP62	Indonesia	17	OI
Ashkhabad	15	LM97	Canberra	19	QF44	Faerros	12	IP62	Iony, O. Sv	21	OO16
Asuncion	11	GG14	Canton Island	5	AJ47	Faial	12	HM58	Iowa	9	EN
Atau	5	AI31	Cape Canaveral	8	EL98	Fairbanks	6	BP64	Iran	15	LM
Athens	15	KM17	Cape Town	13	JF96	Fakaofu	5	AI40	Iraq	15	LM
Athinal	15	KM17	Cape Verde Islands	11	HK	Falkland Islands	10	GD08	Ireland	12	IO
Athos	15	KN20	Caracas	8	FK60	Fanning Island	5	BJ03	Irkutsk	18	OO22
Atiu	5	BH00	Cargados Carajos	14	LH93	Fernandina, Isla	5	EI49	Isabela, Isla	8	EI49
Attu Island	21	RO62	Carney Island	15	CB95	Fernando D. Noronha, I.	11	HI36	Islamabad	18	MM63
Auckland Islands	19	RD39	Caroline Islands	5	BI40	Fiji	20	RH	Island	12	
Australia	20		Caroline Islands	20	QJ	Filippo Reef	5	BI43	Isle of Man	12	IO74
Austria	15	JN	Cayenne	11	GU34	Finland	15	KP	Israel	15	KM
Aves	8	FK85	Cayman Islands	8	EK99	Flinders Island	19	QE49	Italia	15	JN
Axel Heiberg Island	9	EQ	Central African Rep.	14	KJ	Flint Island	5	BH48	Italy	15	JN
Azerbaijan	15	LN	Ceskoslovenska	15	JN	Flores (Indonesia)	20	PI01	Ivory Coast	11	IJ
Azerbaydzanskaya SSR	15	LN	Ceuta	12	IM75	Flores (Portugal)	12	AF49	Jabal at Talr	14	LK05
Azores	12	IM	Chad	15	KM	Fog	11	HK74	Jakarta	17	OI33
B.R.D.	15	JN	Chagos Archipelago	17	MI	Formigas, Ilheus Das	12	HM77	Jaica	8	FK18
Baffin Island	9	FP	Changsha	17	OL68	Fortaleza	11	HI06	Jan Mayen	12	IO50
Baghdad	15	LM23	Chatham Island	4	AE16	France	15	JN	Japan	21	PM
Bahamas, The	8	FL	Cheju Do	21	PM33	Franklin Island	19	RB43	Jarvis Island	5	AJ99
Bahrain	14	LL56	Chelyabinsk	18	MO05	Franz Josef Land	15	LR	Jawa	17	OI
Baker Island	5	AJ10	Chengdu	18	OM20	Freetown	11	JI38	Jersey	12	IN89
Baku	15	LN40	Chicago	9	EN61	French Frigate Shoals	5	AL63	Jerusalem	15	KM71
Baleares, Islas	15	JM19	Chilio	7	FE37	French Guiana	11	GJ	Jinan	18	OM86
Bali's Pyramid	19	QF38	Chioe, Isla De	7	FE37	French Polynesia	5	BH	Johnston Island	5	AK56
Baliy Islands	19	RC13	China	18		Frunze	18	MN72	Jordan	15	FK18
Bamako	11	IK62	Chita	18	OO62	Fuenteventura	11	IL28	Juan De Nova	14	LH12
Banaba	20	RI49	Chongqing	17	OL39	Futuna	5	AH05	Juan Fernandez, Islas	7	FF06
Bangka	17	OI37	Christmas I. (Austr.)	17	OH29	G.D.R.	15	JO	Jugoslavia	15	JN
Bangkok	17	OK03	Christmas I. (Kirib.)	5	BU11	Gabon	14	JI	Kabul	18	MM44
Bangladesh	17	NL	Clarion, Isla	8	DK28	Galapagos, Islas	8	EL	Kahoolawe	15	BL10
Bangul	14	JQ4	Cluperton	8	DK50	Gambia, The	11	IK23	Kaliningrad	15	KO04
Banks Island	6	CO	Coats Island	9	EP82	Gambier, Iles	5	CG26	Kampala	14	JI60
Barbados	11	GK03	Cochons, Ile Aux	13	LE53	Gardner Island	5	AI25	Kampuchea	17	KM
Barbuda	8	FK97	Coco, I. D. (Costa Rica)	8	EJ65	Gardner Pinnacles	5	AL55	Kangaroo Island	19	PF84
Barentsoya	15	KQ08	Cocos Islands (Austr.)	17	NH87	Geneve	15	JN36	Kansas	9	EM
Barnaul	18	NO13	Colombia	8	FJ	Genovesa, Isla	8	EJ50	Karachi	17	ML34
Bass, Ilets De	5	BG82	Colombo	17	MJ96	Georgetown	11	GJ06	Karaganda	18	MN69
Bassas Da India	14	KG98	Colorado	9	DM	Georgia (U.S.A.)	9	EM	Karaginskij, Ostrov	21	RO28
Batavia	17	OI33	Comoros	15	LH	Georgia (U.S.S.R.)	15	LN	Kathmandu	17	NL27
Bathurst Island	9	EQ	Conakry	17	IJ39	Gerald, Ostrov	6	AQ21	Asuati	5	BL02
Beijing	18	OM89	Congo	14	JI	German Dem. Rep. (East)	15	JO	Kaula	5	AL91
Belau	20	PJ	Connecticut	9	FN31	Germany, Fed. Rep. (West)	15	JO	Kazakhskaya S.S.R.	18	
Belem	11	GI58	Cook Islands	5	BH	Ghana	11	JI	Kazakhstan	18	
Belgie	15	JO	Copenhagen	15	JO65	Gibraltar	12	IM76	Kazan	15	LO45
Belgium	15	JO	Corse	15	JN42	Gilbert Islands	20	RI	Kentucky	9	EM
Belgrade	15	KN04	Corvo	12	HM49	Gilbert Islands	20	RI	Kenya	14	KJ
Belize	8	EK57	Costa Rica	8	EL	Ginjeuses, Iles	14	FK38	Kerguelen, Iles	16	ME40
Belorusskaya S.S.R.	15	KO	Coulman Island	19	RB46	Godthab	12	GP44	Kermadec Islands	4	AF
Benin	14	JJ	Crete	15	KM25	Gomera	11	IL18	Khar'kov	21	PN78
			Crozet, Iles	13	LE53	Gorkiy	15	LO16	Khartum, El	14	KK65
						Gotland	15	JO97	Kigali	14	KI58
									Kirgiz Island	19	QF20

King William Island	9 EP	Mbabane	14 KG53	Panama	9 FJ	San Salvador	8 EK53
Kingman Reef	5 AJ86	Mednyy, Ostrov	21 RQ34	Papua New Guinea	20 QJ	San'a	14 EK25
Kingston	8 FK17	Melbourne	19 QF22	Paracel Islands	17 OK66	Santa Cruz, Isla	8 EK48
Kinshasa	14 JI75	Meiella	12 IM85	Paraguay	11 GG	Santa Maria, Isla	8 E148
Kirgiziya	18 MN	Mellish Reef	20 QH72	Paramaribo	11 GU25	Santa Maria	12 HM76
Kirgizskaya S.S.R.	18 MN	Melville Island	9 DQ	Parece Vela	20 PL80	Santa Rosa Island	6 CM93
Kiribati	20 RI	Mexico (City)	8 EK09	Paris	15 JN18	Santiago	7 FF46
Kiyev	15 KO50	Mexico	8 DL	Pascua, Isla De	8 DG52	Santo Antao	11 KH77
Kobenhavn	15 JO65	Michigan	9 EN	Pearl and Hermes Reef	5 AL27	Santo Domingo	8 FK58
Kodiak Island	6 BO37	Micronesia	20 QJ	Pennsylvania	11 JQ15	Sao Jorge	12 HM58
Kokuyev, Ostrov	15 QF19	Middleton Reef	20 QG90	Pern	15 LO88	Sao Miguel	12 HM77
Komandorskiye Ostrova	21 RQ34	Midway Islands	5 AL18	Perth	15 LO78	Sao Nicolau	11 HK76
Komsomolets, Ostrov	18 NR	Minami-Tori-Shima	20 QL64	Peru	8 FI	Sao Pedro E Sao Paulo	11 HJ50
Kingsoya	15 KQ48	Mindanao	20 FJ	Peter I OY	7 EC41	Sao Tiago	11 HK85
Korea, North	21 PN	Minnesota	9 EN	Philippines	20 PK	Sao Tome	14 JJ30
Korea, South	21 PM	Minsk	15 KO33	Phillip Island	20 RG30	Sao Vicente	11 HK76
Kotel'Nyy, Ostrov	21 QQ	Miquelon	12 GN16	Phnom Penh	17 OK21	Sardagna	15 JN
Krasnoyarsk	18 NO66	Mississippi	9 EM	Phoenix Islands	5 AI	Saskatchewan	9 DO
Kriti	15 KM25	Missouri	9 EM	Pico	12 HM58	Saudi Arabia	14 LI
Krug Ship	17 OK03	Mocho, Isla	7 FF31	Pingouins, Iles Des	13 LE53	Savali	5 AH36
Kuala Lumpur	17 OJ03	Mogadiscio	14 LJ22	Pinta, Isla	8 EJ40	Scotland	12 IO
Kure Island	5 AL08	Moldavia	15 KN	Pioneer, Ostrov	18 NQ	Scott Island	19 RC92
Kuril'Skiye Ostrova	21 ON	Moldavskaya S.S.R.	15 KN	Pitcairn Island	5 CG44	Sevagens, Ilnas	12 IM20
Kuwait	14 LL39	Molokai	5 BL11	Pitt Island	4 AE15	Senegal	11 IK
Kuwait, Al	14 LL49	Monaco	15 JN33	Poland	15 JO	Seoul	21 PM37
Kuybyshev	15 LO53	Mongolia	18 ON	Polska	15 JO	Seram	20 PI
Kvityosa	15 KR60	Monrovia	11 JA46	Polyisia, French	5 BH	Severnaya Zemlya	18
Kyushu	9 JN	Montana	9 DN	Port Moresby	20 QI30	Shag Island	16 MD67
L'Esperance Rock	4 AL08	Montreal	8 DL95	Port Moresby	20 QI30	Shag Rocks	10 GD96
La Palma	11 IL18	Montevideo	10 GF15	Port-Au-Prince	8 FK38	Shanghai	21 PM01
La Paz	8 FH53	Montserrat	8 FK86	Portonovo	14 JJ16	Shannon	12 IQ05
Labrador	9 FO	Morocco	12 IM	Portugal	12 IM	Shenyang	21 PN11
Laccadive Islands	17 MK	Moscow	15 KO85	Possession, Ile De La	13 LE53	Shepard Island	4 CB45
Lagos	14 JJ16	Moskva	15 KO85	Prague	15 JO70	Shikoku	21 PM63
Lakshadweep	17 MK	Mozambique	14 KH	Praha	15 JO70	Shqipëria	15
Lanal	5 BL40	Muransk	15 KF8	President Thiers, Rec.	15 JQ15	Shriur	17 NI98
Lancaster, Recife	5 GB63	N'Djamena	15 KF72	Pretoria	14 KG44	Sicilia	15 JM
Lanzarote	11 IL39	Nairobi	14 KI88	Pribilof Islands	6 AO47	Sierra Leone	11 IJ
Laos	17 OK	Namibia	14 JG	Prince Charles Island	9 FP17	Singapore	17 OJ11
Latvia	15 KO	Nanjing	18 OM92	Prince Edw. I. (Canada)	9 FN86	Sint Eustatius	8 FK87
Latviyskaya S.S.R.	15 KO	Nassau	5 AH78	Prince Edw. I. (Sou.AF)	13 KE83	Sint Maarten	8 FK88
Laysan Island	5 AL45	Nauru	20 RI39	Prince of Wales I.	9 EQ	Sjælland	15 JO65
Lebanon	15 KM73	Navassa Island	8 FK28	Prince Patrick Island	9 DQ	Snare Islands	19 RE31
Leningrad	15 KO59	Nebraska	9 EN	Prince	14 JJ15	Sociedade, Iles De La	8 DK48
Lesotho	14 KG	Netherlands	15 JQ73	Providence, Isla De	8 EK93	Sofiya	15 KN22
Liberia	11	Nederland	15 JO	Puerto Rico	8 FK68	Solitaire, Ile	16 MD49
Libreville	14 JU40	Nepal	17 NL	Pukapuka	5 AH79	Solomon Islands	20 QI
Libya	14 JL	Netherl. Antilles	8 FK52	Pyongyang	21 PM29	Somalia	14 LJ
Lichtenstein	15 JN47	Netherlands	15 JO	Qatar	14 LL55	Somerset Island	9 EQ
Lilongwe	14 KH66	Nevada	9 DM	Quebec	9 FO	Soul	21 PM37
Lima	8 FH17	Nevis	8 FK87	Queen Charlotte Is.	6 CO33	South Africa, Rep. Of	14
Line Islands	5	New Britain	20 QI	Queen Elizabeth Is.	20 QG	South Australia	19 PI
Lisboa	12 IM58	New Brunswick	9 FN	Queen Island	8 FIO9	South Carolina	9 EM
Lisianski Island	5 JI36	New Caledonia	20 QJ	Rabat	12 IM64	South Dakota	9 DN
Lithuania	15 KO	New Guinea	20 QI	Raivavae	5 BG66	South Georgia	10 HD15
Litovskaya S.S.R.	15 KO	New Hebrides	20 RH	Rakahanga	5 AH9	South Orkney Islands	10 GC79
Lofoten	15 JP	New Ireland	20 QI	Rangoon	17 NK86	South Sandwich Is.	10 HD
Lome	14 JU06	New Jersey	9 FN	Raoul Island	5 AG10	South Shetland Is.	10 GC
London	12 IO91	New Mexico	9 DM	Rapa Ili	5 BG72	Southampton Island	9 EP
Long Island	9 FN30	New South Wales	19 QF	Ratonga	5 BG08	Soviet Union	15
Lord Howe Island	19 QF98	New York (City)	9 FN30	Recife	11 HI21	Soyuz Sov. Sots. Res.	15
Los Angeles	9 DM03	New York (State)	9 FN	Reunion	14 LG78	Spain	12 IN
Louisiana	9 EM	New Zealand	19 RE	Revilla Gigedo, Islas	8 DK	Spitsbergen	15 JQ
Lunda	14 JI61	Newfoundland	12 GN	Reykjavik	12 HP94	Sporadhes	15 KM
Lusaka	14 KH44	New Hampshire	9 FN	Rhode Island	9 FN41	Spratly Island	17 OJ58
Luxembourg	15 JO20	Naimey	14 JK13	Rimataru	5 BG37	Sri Lanka	17 NJ
Luzon	20 PK	Nias	17 NJ81	Rio De Janeiro	11 GG87	Starbuck Island	5 BI24
Macau	17 OL62	Nicaragua	8 EK	Riyad, Ar	14 LG34	Stefansson Island	19 Q73
Macaleya Island	4 AF09	Nicobar Islands	17 NJ	Robinson Crusoe, Isla	7 LQ30	Stewart Island	19 RE32
Macdonald Islands	16 MD67	Nicosia	15 KM65	Roca Partida, Isla	8 DK39	Stockholm	15 JO99
Macdonald Rock	4 MD67	Niger	14 JK	Rocas, Atlo Das	11 HI36	Store Koldewey	12 IQ06
MacKenzie King Island	9 DQ	Nigeria	14 JG	Rockall	12 IO37	Storoya	15 KR30
Macquarie Island	19 QD95	Nightingale Island	10 IF32	Rodriguez Island	17 MH10	Sturge Island	19 RC22
Madeira	12 IM12	Nihoa	5 AL93	Roma	15 JN61	Sudan	14 KK
Madras	17 NK03	Niihau	5 AL91	Romania	15 KN	Sulawesi	20 PI
Madrid	12 IN80	Nippon	21 PM	Roosevelt Island	4 AB90	Sumatera	17
Magnitogorsk	15 LO93	Nlue	5 AH50	Rose Island	5 H55	Sumba	17 OI90
Magyarorszag	15 JN	Nordaustrandet	15 KO	Ross Island	19 RB32	Sumbawa	17 OI81
Mahe	14 LI75	Norfolk Island	20 RG30	Rossiyskaya S.F.S.R.	15	Sumisu-Jima	21 QM01
Mahe	9 JN	Norge	19 FM	Rostov	15 KN97	Suomi	15 KP
Malio	11 HK85	North Carolina	9 FN	Rowley Shoals	17 OH92	Suqutra	14 LK62
Malagasy	14 LH	North Dakota	9 DN	Rurutu	5 BG47	Surinam	11 GJ
Malawi	14 KH	Northern Ireland	12 IO64	Russian S.F.S.R.	15	Suvorov Island	5 AH86
Malaysia	17 OJ	Northern Territory	20 PH	Rwanda	14 KI	Svalbard	15 JO
Malden Island	5 BI26	Northwest Territories	9	S.S.S.R.	15	Svenskoya	15 KO38
Maldive Islands	17 MJ	Norway	15 JP	Saba	8 FK87	Sverdlovsk	18 MO06
Mali	11 IK	Nouakchott	11 IK28	Sable Island	12 GN16	Sverige	15 JP
Mallorca	15 JM19	Nouvelle Caledonie	20 RG	Saint Croix	8 FK77	Swains Island	5 AH48
Mameloto, Isla De	5 EJ93	Novaya Scotia	9 FN	Saint Helena	11 IH74	Swaziland	14 KG53
Malta	15 JM75	Novaya Sibir, Ostrov	21 QO45	Saint Kitts	8 FK87	Sweden	15 JP
Malvinas, Islas	10 GD08	Novaya Zemlya	15 LQ	Saint Lawrence Island	6 AP43	Switzerland	15 JN
Managua	8 EK62	Novosibirsk	18 NO15	Saint Lucia	8 FK93	Sydney	19 QF56
Mangaia	5 BG18	Novosibirsk, Ostrova	21 QO51	Saint Martin	8 FK88	Syria	15 KM
Manihiki	5 AH99	Nuku Hiva	5 BI91	Saint Matthew Island	6 H672	T'AI-Pei	21 LO5
Manila	20 PK04	Nukunono	5 AI40	Saint Paul Island	9 FN97	Tadzhikistan	18 MM
Manitoba	9 EO	Nunivak Island	6 AO69	Saint Peter & St.Paul	11 HJ50	Tadzhikskaya S.S.R.	18 MM
Marais Island	9 P	Oeno	5 CG46	Saint Vincent	8 FK93	Tahiti	5 BH52
Marau Islands	5 AH55	Ogasawara-Gunto	20 QL	Saint-Pierre	12 GN16	Taiwan	20 PL
Maputo	14 KG64	Ohio	9 EN	Sakhalin	21 QO	Tanzania	14 KI
Marchena, Isla	8 EJ40	Okinawa	20 PL36	Sal	11 HK86	Tarabulus Al Gharb	15 JM62
Maria Theresa Reef	4 BF42	Oklahoma	9 EM	Sal'a Gomez	8 DG73	Tashkent	18 MN41
Maria, Iles	5 BG28	Oktyabr'Skoy Rev., O.	18 NQ	Salisbury, EL	14 KH62	Tasmania	17 QF72
Mariana Islands	20 QK	Oman	14 LL	Salvador, EL	8 EK53	Tegucigalpa	8 EK64
Marion Island	13 KE83	Omsk	18 MO65	Salvador	11 HM07	Tehran	15 LM55
Markel	15 JP90	Ontario	9 CN	Samoa	5 AH	Tenerife	11 IL18
Mario Reef	5 LM45	Oregon	15 JO59	San Ambrosio, Isla	8 FG03	Tennessee	9 EM
Marquises, Iles	5 CI	Oslo	15 JN	San Andres, Isla De	8 EK92	Terceira	12 HM68
Marshall Islands	20 RJ	Osterreich	15 JN	San Benedicto, Isla	8 DK49	Texas	17 OK
Martin Vaz, Ilnas	11 HG59	Ottawa	9 FN25	San Cristobal, Isla	8 E159	Thailand	17 OK
Martinique	8 FK94	Ouagadougou	11 IK92	San Felix, Isla	8 DG73	Thimbu	17 NK47
Maryland	9 FM	Pagalu	14 JI28	San Francisco	6 CM87	Three Kings Islands	19 RF65
Maseru	14 KG31	Pakistan	17 PJ	San Jose	8 EJ79	Thurston Island	7 EB
Massat	14 LL93	Palau Islands	20 FL	San Marino	15 JN63	Tierra Del Fuego	7 FD55
Massachusetts	9 JN	Palmerston Island	5 AH81	San Miguel Island	6 CM94	Timor	20 PI
Maui	5 BL01	Palmyra Island	5 AJ85	San Salvador, Isla	8 E149	Tirana	15 JN91
Mauritania	11 IL	Panama (City)	8 FJ08			Tobago	8 FK91



Tofua	5	AH20	U.S.A.	9	Victoria Island	9	DQ	Western Samoa	5	AH36
Togo	14	JJ	U.S.S.R.	15	Victoria	19	QF	White Russia	15	KO
Tokelau Islands	5	AI	Uganda	14	Vientiane	17	OK17	Wien	15	JN88
Tokyo	21	PM95	Ukraine	15	Vietnam	17	OK	Willis Group	20	QH
Tomsk	18	NO26	Ukrainakaya S.S.R.	15	Viktoriya, Ostrov	15	KR80	Windhoek	14	JG87
Tonga	5	AG	Ulaanbaatar	18	Virgin Islands (U.K.)	8	FK78	Wisconsin	9	EN
Tongareva	5	BI11	Union of Sov. Soc. R.	15	Virgin Islands (USA)	8	FK78	Wuhan	18	OM70
Tori-Shima	21	QM00	United Kingdom	12	Virginia	9	FM	Wyoming	9	DN
Trindade, Ilha Da	11	HG59	United States of Ame.	9	Viti Levu	20	RH	Xi'an	18	OM44
Trinidad (Trin.&Tob.)	8	FK90	Upolu	5	Vize, Ostrov	18	MQ89	Yakutsk	21	PP42
Trinidad (Brazil)	11	HG59	Uruguay	10	Vladivostok	21	PN53	Yaounde	14	JJ53
Tripoli	15	JM62	Upper Volta	11	Volgograd	15	LN28	Yap	20	PJ99
Tristan Da Cunha	10	IF32	Uruguay	10	Vostok Island	5	BH39	Yaroslavl	15	KO97
Tromelin, Ile	14	LH74	Ushakov, Ostrov	18	Vrangelya, Ostrov	6	AC01	Yemen, P.D.R. (South)	14	LK
Tuamotu	5	BH	Utah	9	Wake Island	20	FK39	Yemen	15	LM
Tubuai, Iles	5	BG56	Uzbekistan	18	Wales	12	IO	Yerushalayim	15	OM71
Tubuai, Iles	5	BG	Uzbekskaya S.S.R.	18	Wallis, Iles	5	AH16	Young Island	19	RC13
Tunis	15	JM56	Vancouver Island	6	Warsaw	15	KO02	Yugoslavia	15	JN
Tunisia	15	JM	Vanua Levu	20	Washington (State)	6	CN	Yukon Territory	6	CP
Turkey	15	KM	Vanuatu	20	Washington Distr.Col.	9	FM18	Zaire	14	KI
Turkmenistan	15	JM	Vaticano	15	Washington Island	5	AJ94	Zambia	14	KH
Turkmenkaya S.S.R.	15	FL41	Vava'u	5	Wellington	19	RE78	Zemlya Frantsa Iosifa	15	LR
Turks Islands	8	FL41	Vaygach, Ostrov	15	Wenman, Isla	8	EJ41	Zemlya Georga	15	LR40
Tuvalu	5	AH45	Venezuela	8	West Virginia	9	EM	Zimbabwe	14	KH
Tuvalu	20	RI	Vermont	9	Western Australia	20	PG			

## FIELD MAP



## Who Will Be The First Radio Amateur To Work All 324 Fields On The Same Band?

The Maidenhead Locator System has been adopted by all three regions of the International Amateur Radio Union (IARU). Now we have an excellent opportunity to start collecting the largest unit "field". Since the end of 1982 the author has been compiling a list of fields worked on the VHF and UHF bands. This list will now be extended to all amateur radio bands. If the author has counted correctly, 262 fields are covered by some kind of land, 8 fields are covered by permanent ice without land and 54 fields are covered by the open sea. To get all the 324 fields both sea expeditions and polar expeditions should be needed.

You are invited to send your number of fields worked on the same band together with your home field to the address below, and you will be noted on the list. Rules: 1. All fields must have been worked on natural modes of wave propagation (no active satellites). 2. QSL cards are not required but you must be sure that both stations consider the QSO complete. 3. All QSOs must have been worked from points within a circle of 1000 km radius.

The list is compiled 4 times a year, and is published in a number of amateur radio magazines. If you cannot get the list in any other way, the list may be ordered directly from the address below if you enclose a self-addressed envelope without stamps together with 2 IRCs. There is no copyright for the field list and the author is only glad if it is copied and shown to as many radio amateurs as possible.

Anyone having comments or additional information is welcome to write to the address below.

## Projection and Scale

The projection is rectangular on all maps with the longitude/latitude ratio 1/1 at 45 degrees latitude.

Folke Rosvall, Box 8037, S-191 08 Sollentuna, Sweden













# TITAN ANTENNA

## INSTALLATION AND ASSEMBLY INSTRUCTIONS



**GAP ANTENNA PRODUCTS, INC.**

6010 Bldg. B

N. Old Dixie Highway

Vero Beach, Florida 32967

(407) 778-3728

## SAFETY NOTICE

### PG 1

#### **WARNING! POWER LINES CAN KILL.**

DO NOT ERECT THIS ANTENNA NEAR ANY OVERHEAD WIRES, UNDER ANY CIRCUMSTANCES. READ AND FOLLOW THESE INSTRUCTIONS CAREFULLY:

- 1) Do not erect this antenna near any overhead wires. Assume all such wires to be power lines and deadly.
- 2) Do not transport this antenna from an assembly location to the installation site, if you must travel near or under overhead wires.
- 3) Request advice from your local power company, if power wires are anywhere near the proposed installation.
- 4) If the antenna falls, do not try to stop it. Get out of the way.
- 5) If any part of the antenna should touch overhead wiring, **DO NOT TOUCH IT!** Call the power company immediately for help.
- 6) In the event of an accident involving power wiring:  
**DO NOT TOUCH THE VICTIM DIRECTLY.** Send someone for help.
- 7) Select a site which limits public access to the antenna. During operation the lower tuner rods can be at High RF potential. If any possibility exists that people or pets could touch the antenna, place a small wooden fence around the antenna after installation.
- 8) Choose a calm, dry day to erect the antenna.
- 9) Always enlist the aid of at least one person in erecting the antenna.
- 10) Do not use or stand on a ladder in the process of erecting your GAP Antenna. A ladder is not needed and could be dangerous.
- 11) Do not connect the antenna coax until the antenna is firmly mounted.



Congratulations on your purchase of the GAP TITAN antenna. You soon will enjoy the ultimate in vertical antenna technology. Your GAP antenna has been designed and manufactured to provide superior performance, and a long trouble free life.

GAP technology produces highly efficient, wide bandwidth performance. As a result, no tuning is required in most amateur installations. This manual is organized to minimize the amount of time necessary to assemble and install your GAP vertical. It is recommended that you follow the instructions and use the figures as a guide.

Before beginning assembly, take a few minutes to read through the site selection chapter and to review the SAFETY notices. Please refer to Figure 1, the TiTAN Antenna, as you proceed with the assembly. Locate the parts from Figure 2.

The TITAN has been designed to operate efficiently on eight bands at 1500 watts PEP or less. The TITAN cannot be run continuously ie Amtor, RTTY at maximum power on 75/80 meters.

The use of an antenna tuner is not required. Tuners will not improve the performance of the TITAN, however they may permit a solid state transmitter to put out increased power. Operation of an antenna tuner when the VSWR is 2:1 or less is permitted. High power operation outside the specified bands using a tuner can damage the antenna.

#### **CHAPTER 1: SITE CONSIDERATIONS**

SAFETY, nearby structures, buildings, guying

#### **CHAPTER 2: ANTENNA MOUNTING**

Pole, tower, or chimney

#### **CHAPTER 3: MAST ASSEMBLY**

Space required, Mast Assembly, Step by Step

#### **CHAPTER 4: TUNER ROD ASSEMBLY**

Top, Mid, Lower and Extensions

#### **CHAPTER 5: COUNTERPOISE AND MOUNT ASSEMBLY**

#### **CHAPTER 6: INITIAL TEST**

First operation...a place to record VSWR data

#### **CHAPTER 7: TIPS AND TROUBLE SHOOTING**

**READ THE SAFETY NOTICE ON PAGE 1 BEFORE CONTINUING**

### 1.0 General

Ideally, it is best to locate the TITAN in a clear area, away from wires, metal buildings, fences and trees. As a practical matter, many amateurs must compromise in locating their antennas. This section contains specific guidelines to assist in making those compromises.

#### 1.1 Site Safety

A) If you have not read the safety notice, do so now. Stay away from power lines, they are life threatening.

B) Choose a site that it is not easily accessible to people or pets.

**CONTACT WITH THE ANTENNA IS DANGEROUS AND CAN BE FATAL.**

The counterpoise rods and the rest of the TITAN may be at high RF potential during operation. If it not possible to site the TITAN to prevent access, then it should be placed high enough such that people cannot reach it or surround it with a fence.

#### 1.2 Nearby Wires and Antennas

A) In general, any vertical antenna can exhibit mutual coupling with any other vertical metal structure or wire if placed within a few wavelengths or the structure approaches resonance at the operating frequency.

B) Try to avoid metal objects which may be within 30' of the proposed GAP installation site. These may include wires, towers, downspouts, screened porches, feedlines from other amateur antennas or TV antennas, metal pipes on your property or adjoining properties. Naturally, if these metal objects are short you can get closer than 30'.

C) Nearby horizontal wires or structures may affect the performance of a vertical antenna, but they are not as likely to, as a vertical structure is.

#### 1.3 Buildings

A) It is best to locate the antenna as far from the home as possible, to minimize interaction with house wiring, and RFI to consumer electronics.

B) Metal walled or roofed buildings can affect antenna operation. If you have no choice, your GAP should be located at a corner of the building, rather than broadside. In any case, the TITAN should be tested first away from the building. See Section 6.0.

C) Stucco buildings may have metal mesh in their walls and should be viewed as a metal structures, until proven otherwise.

D) Mobile homes or RV's are a special case, which involve individual experimentation. Test the antenna on the ground before attempting installation near or on the RV. Mounting above the roofline is preferred.

#### 1.4 Guying

The TITAN is designed to withstand substantial winds unguyed. Guys are a form of insurance, however, which we recommend. Four nonconductive guy ropes should be fastened above the center insulator. Use a stainless clamp or optional guy clamp available from GAP. Leave some slack to allow for temperature changes. Guys should be used for roof mounting. Do not rely on a chimney mount or tripod to support the TITAN, even moderate winds can produce enough force to damage the mount or the chimney.

## 2.0 General

The TITAN will accommodate a variety of mounting situations, some of which are described below. The preferred mount is a pole mount. It is simple and avoids the hazards of a roof top installation. Electing to roof mount the antenna is solely your decision and extreme caution should be exercised.

If you elect to elevate the antenna, always pre-test the antenna on the ground first. See Section 6.0 Locating a loose connection when the antenna is on top of a 40' mast is not easy!!

## 2.1 Pole Mounting

The TITAN is designed to be pole mounted. A mount plate assembly has been provided to attach the TITAN to a pole of your choice. It is recommended that you select a very heavy gauge steel pipe. The outside diameter of which should be 1.25". This pole may be attached to the side of a structure ie house or garage for additional support. If you elect to side mount, be certain your pole extends above the roof line to allow clearance for the Counterpoise hoop. Three foot clearance is typical.

If you elect to mount the TITAN on a pole in the yard, the pole should be mounted in an 18" diameter hole 3 feet deep or more and filled with concrete. It is far easier to erect the antenna with your support pole attached, rather than trying to lift the TITAN onto your support pipe. Thus your support pole should be such that it is removable from the concrete. To achieve this, procure a 3' length of 1.25" schedule 40 PVC. Make sure it will sleeve over your support pipe, if it is not large enough slit the pipe lengthwise and slide it over your pipe. Cover the slit with tape and place the PVC covered pipe in the 3' hole and fill with concrete. When the concrete has set remove your support pipe. You can now drop your support pipe into the hole you created by your PVC form.

## 2.2 TOWER MOUNTING

The TITAN may be mounted to a tower. Do not clamp directly to the tower. Use the Mount Plate Assembly to insulate the TITAN from the tower itself or the support. The TITAN must be placed at the top of the tower and not parallel with it. You may experience reduced bandwidth on a band if you tower mount the TITAN. This is generally a result of the tower exhibiting a resonance for that frequency.

## 2.3 TRIPOD/CHIMNEY MOUNT

The TITAN may be mounted in a tripod or to a chimney mount. Use the mount plate assembly to insulate the TITAN from the tripod or chimney mount.

**CAUTION** The TITAN and mount are in excess of 29' tall. Under no circumstances should a tripod or chimney mount exist without guy ropes. Guy the antenna!



### 3.0 General

The assembly of the GAP TITAN requires no special tools and a nut driver has been supplied for your convenience. Plastic stand-offs that support the tuner rods are attached to the aluminum mast at their approximate proper positions to simplify assembly. Do not remove these at this time. Before starting assembly, check the various parts in the shipping container against the pictorial parts list in figure B to establish all parts are present. Next review Figure A which depicts an assembled TITAN. As you proceed to assemble your Titan, use this diagram.

**NOTE:** That in the assembly instructions, when a single hole is identified on a tuner rod it is thru drilled. Thru drilled holes provide you with a backup should you accidentally strip a hole by over tightening.

We found that telling you to insert a screw and washer gets repetitive, therefore whenever a screw is called for include a washer as well. When attaching jumpers and transitions, the washer should be placed between the ring terminal and the tube. Not between the screw head and ring terminal. When we refer to the "GAP" we are referencing the center insulator with the yellow band.

### 3.1 Space Required

To get started with the assembly, you will need a flat space approximately 30' in length. A driveway or patio surface is ideal. The key to an easy assembly is room to move, a surface which allows you to find the screws you drop and careful attention to the directions. Extra screws have been provided because we know how lawns like to eat screws.

### 3.2 Mast Assembly

Standoffs are positioned on the various mast sections at their approximate final positions. Do not loosen the clamps.

A) Locate the Main Section. Place the Main Section on a flat surface.

Stretch out the coax that protrudes from each end. NOTE The coax that goes to the top of the antenna has a yellow ring terminal.

B) Locate the Top Section. Place the end without the notch over the coax cable with the yellow terminal.

C) Slide the Top Section into the Main Section. Gently push the Top Section into the Main Section beyond the matching holes, until the yellow terminal and spade connectors are exposed.

D) Plug the CAP unit onto the spade connectors found on the coaxial cable. **Make sure the male spades on the CAP unit align with the female spade terminals on the coax.**

E) Pull the Top Section back out and align it's four screw holes with the four holes in the Main Mast Section. Insert 4 screws and tighten securely.

F) Place the yellow ring terminal at the top of the antenna through the slot and over the nearby drill hole. Insert a screw and tighten securely.

**WARNING:** Make sure the CAP unit is pushed down below the screw, so it does not crack the CAP unit when you insert it.

G) Locate the black dust cover and place it over the Top Section.

H) Locate the Mid Section. It has 4 standoffs attached to one end. Slide the end with the 4 standoffs over the coax tail protruding from the Main Section center insulator.

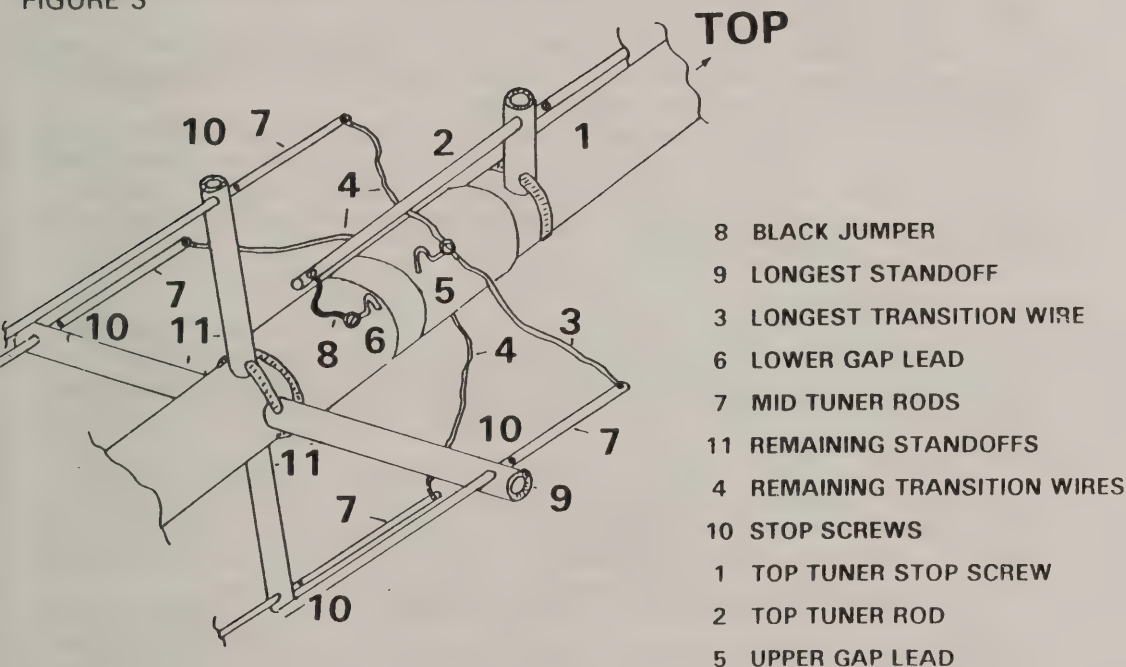
I) Align the holes on the insulator with the holes in the Mid Section. Insert 4 screws and tighten. Leave the standoffs as is for the moment.

J) Locate the Lower Section. It is a double wall section for added strength. It has four long standoffs at one end.

K) Slide the end with the standoffs over the coax tail and partially over the Mid Section. Align the 4 holes, insert 4 screws and tighten securely.

## CHAPTER 4: TUNER ROD ASSEMBLY

FIGURE 3



### 4.0 GENERAL

There are four 102" Mid tuner rods, two Lower tuner rods 30" and 60" and one 51" Top tuner rod. Two extender rods complete the tuner rod package. The standoffs have been prepositioned at the factory for your convenience. When orienting these standoffs you should not have to move them along the mast, but simply twist them in their shipped position. If you should slightly shift their relative position along the mast don't despair. Slight movement is not critical.

A) Locate the two short standoffs on the Main Section. Slide the 51" Top tuner rod thru these standoffs so the screw holes are towards the GAP. Loosen and adjust the standoffs so the tuner rod is parallel to the mast, now tighten the clamps.

B) Locate the drill hole 10" from the end of this tuner rod. Position this hole between the two standoffs and insert a screw and tighten. This is a stop screw

C) Slide the tuner rod toward the GAP. Locate a black jumper. Remove the screw holding the lower GAP lead, see fig. 3. Place the black jumper under the screw with the GAP lead, reinsert and tighten.

D) Attach the other end of the jumper to the hole at the end of the Top tuner rod with a screw and tighten.

E) Locate the four standoffs on the Mid section just below the GAP. Loosen their clamp. Form these four into a cross, perpendicular and immediately below the GAP. Tighten the clamp securely.

F) Locate the four standoff assembly at the top of the Lower Section. Form these four into a cross perpendicular to the mast. Tighten the clamp **lightly**. Now locate the longest standoff on the upper cross assembly. Rotate the lower cross assembly until it's longest standoff is in line with the one on the upper unit. Tighten the clamp.

G) Take the four 102" Mid tuner rods and insert a screw in the hole 10" from the end of each rod and tighten. This a stop screw.

H) Slide a 102" rod thru each standoff in the top cross, starting with the end opposite the screw just inserted and then into the bottom standoffs. Each rod should be parallel to the Main mast. You may have to adjust the lower cross unit to achieve parallel rods. Each rod should stop at the stop screw.

I) There are four yellow transition wires at the GAP, one longer than the other three. Attach one to each Mid tuner rod with a screw and tighten. The longest wire attaches to the tuner rod on the longer standoff. All wires should not be taut. If you find a wire is taut it may be necessary to rotate the two cross units to relieve any tension on the transition wires.

J) Locate the 23" extension rod with the attached slotted extender. Locate the Mid tuner on the longer standoffs. Slide the slotted extender over the bottom end of this 102" rod until it butts against the 23" extension. Rotate the extender until the hole in the Mid tuner rod lines up with the slot in the extender. Insert a screw into this hole and slot and tighten. See figure 4.

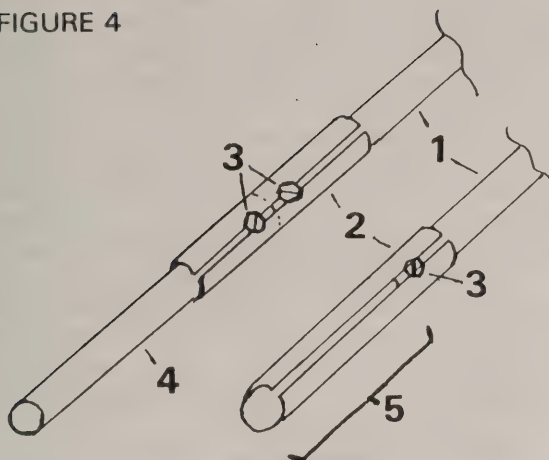
K) Locate the remaining extender and place it over the Mid tuner rod opposite the tuner rod just installed. Align the slot in the extender with the hole on the tuner rod and secure as in J above so it extends 4.5 inches.

L) Loosen the clamp on the short pair of standoffs on the Lower section. Rotate this pair until they line up with the Mid tuner rods without the extenders.

M) Take the last two short standoffs on the Lower section, loosen each clamp and orient one of these standoffs so it is in line with one from the pair above it. Orient the other so it is in line with the remaining standoff of the pair. Tighten the clamps.



FIGURE 4



- 5 EXTEND 4.5"
- 1 MID TUNER RODS
- 2 SLOTTED EXTENDERS
- 3 SCREWS
- 4 23" EXTENSION ROD

N) Slide the shortest Lower tuner rod through the closest spaced standoffs, with the drill hole closest to the GAP. Locate a black jumper and attach one end to the top of the short tuner rod with a screw and tighten.

O) Slide the longer lower tuner rod thru the remaining short standoffs, again, so the screw hole is closest to the GAP. Take the remaining black jumper and attach it to the top of this rod with a screw and tighten.

P) Take the other ends of each black jumper and attach it to the Mid Tuner rod directly above with a screw and tighten. These jumpers should be loose. If they are taut you can raise or lower the position of the clamp on the short standoff pair to remove any tension. Proper positioning can be achieved by making sure the bottom of these two Mid tuner rods are in the same plane as the tops of your Lower tuner rods.

## CHAPTER 5: COUNTERPOISE AND HOOP ASSEMBLY

### 5.0 GENERAL

The Counterpoise and hoop assembly includes a Counterpoise support bracket, 4-80" rods, Counterpoise Hoop - a 35' length of copper wire with a ring terminal, a 4' length of Dacron with a ring terminal, 3 counterpoise End Caps and a 4' 9" fixed wire extension with 2 ring terminals. The Counterpoise hoop replaces the conventional radials of a ground mounted vertical.

### 5.1 Counterpoise Bracket Assembly see figure 5.

A) Locate the Counterpoise bracket. It is partially assembled. Locate the 3/4" x 9" long PVC section with 2 screws attached.

B) Push a 11/4" screw thru one of the vacant holes in the aluminum bracket. Place one of the drill holes in the PVC tube over this screw.

C) Push a second screw thru the remaining vacant hole in the aluminum bracket and then thru the remaining vacant drill hole in the PVC tube.

D) Attach lock nuts to each screw and tighten both securely.

# 9 ALUMINUM COUNTERPOISE TUBE

## 1 COUNTERPOISE RODS

## 4 PVC COUNTERPOISE TUBE

## 8 SCREW

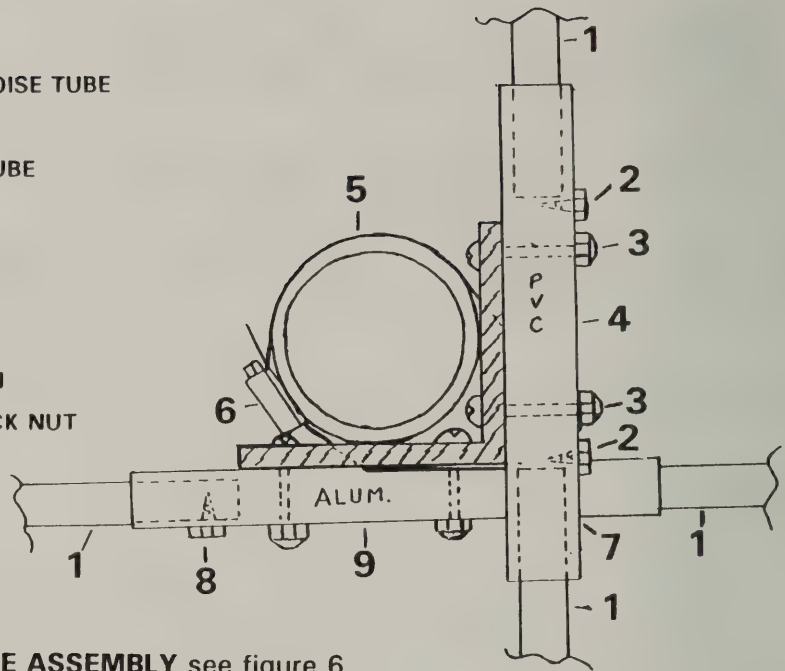
## 7 SCREW - NOT VISABLE

## 6 STAINLESS CLAMP

## 2 STOP SCREW ONLY

## 5 TITAN LOWER SECTION

## 3 11/4" SCREW & NYLOCK NUT



### 5.2 COUNTERPOISE ASSEMBLY see figure 6

A) Undo the clamp on the assembled Counterpoise bracket. Place the bracket against the Lower Section in between the two sets of screws at the base.

B) Reconnect the clamp and tighten securely

It is recommended that the Counterpoise Hoop assembly, be deferred until the TITAN has been installed in it's final position. RAISING the antenna with the hoop installed is cumbersome and can damage the antenna. The following section is easier to complete after the antenna has been mounted. Check section 6.0 before continuing.

### 5.3 COUNTERPOISE HOOP

A) Locate the 80" counterpoise rods. There are drill holes on both ends. Slide each rod into the Counterpoise bracket see figure 5 & 6. Make sure the rod with the yellow end cap slides into one side of the aluminum tube, not the PVC.

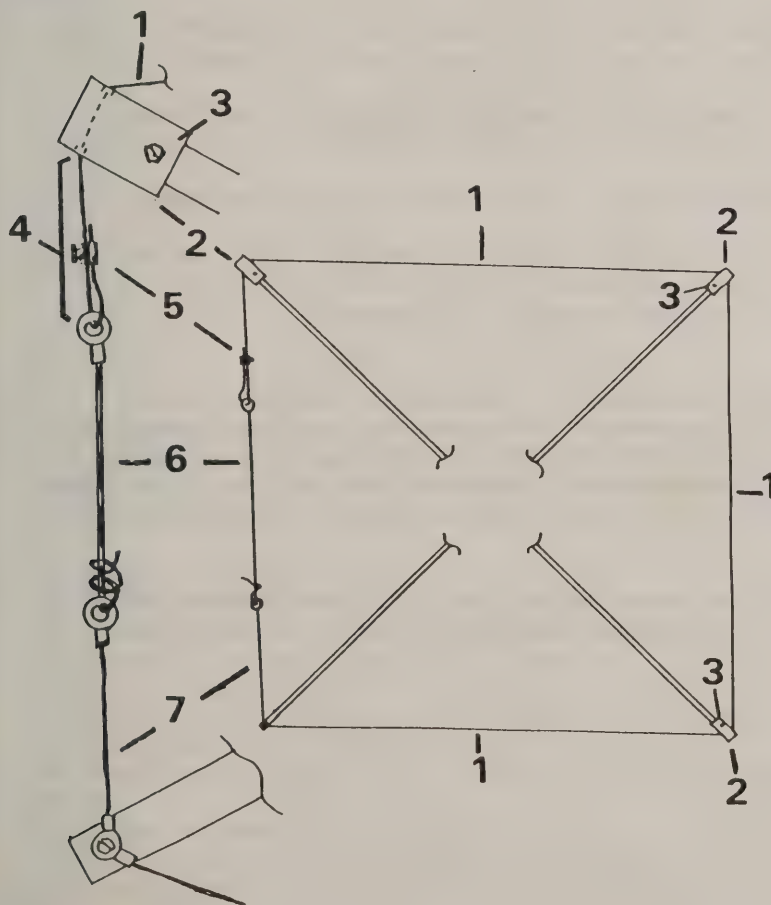
B) Align the hole in the 80" rods with the hole in the counterpoise tubes. Insert a screw in both holes and tighten.

C) Locate the 3 Counterpoise End Caps and the 35 foot tinned copper Counterpoise Hoop with 1 ring terminal. The factory has placed a screw in these End Caps.

D) Each End Cap has a thru drilled hole close to one end. Thread the end of the copper wire without the ring terminal thru these holes in the End Caps.

- E) Locate the wire extension with the two ring terminals.
- F) Take the ring terminal from the Counterpoise Hoop wire and one terminal from the wire extension. Place both terminals over the drill hole at the end of the 80" counterpoise rod that has the yellow end cap and is attached to the aluminum tube on the Counterpoise bracket. see figure 6. Insert a screw attaching these terminals to the Counterpoise rod.
- G) Circle the ends of the Counterpoise rods with the Counterpoise Hoop placing an End Cap on each Counterpoise rod as you circle.
- H) Find the Dacron cord with the ring terminal. Feed the end of the Counterpoise wire thru the ring terminal on the Dacron cord about 18", fold it back on itself and secure with the split bolt.
- I) Thread the Dacron cord thru the vacant ring terminal of the wire extension. Pull the cord until the hoop has no slack in it but, do not over tension the hoop. Tie a temporary knot in the Dacron cord to the ring terminal on the wire extension.

FIGURE 6



- 4 APPROXIMATELY 50"
- 1 COUNTERPOISE HOOP
- 6 DACRON ROPE
- 2 PVC END CAP
- 5 SPLIT BOLT
- 3 STOP SCREW
- 7 WIRE EXTENSION



**IMPORTANT** The length of the Counterpoise Hoop controls the center frequency on 40m. The longer the Counterpoise wire is, the shorter the Dacron rope is and the lower the resonant frequency will be. Likewise the shorter the length of the Counterpoise Hoop the higher the resonant frequency will be and the longer the Dacron rope will be. Adjust the Counterpoise Hoop so that it ends about 50" from the last End Cap and check the frequency with your VSWR meter on 40m. Adjust the length to suit your preference on 40m.

#### 5.4 POLE MOUNT ASSEMBLY-REFER TO FIGURE 7

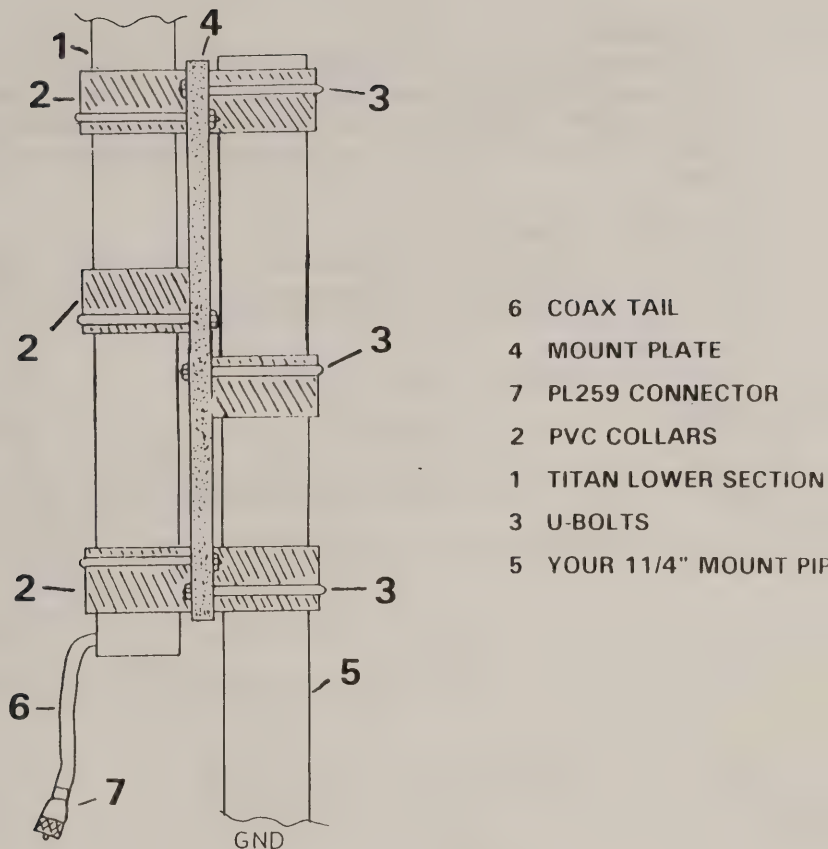
- A) Locate the 3"x12" aluminum plate, the six U-bolts and twelve nuts.
- B) Insert the U-bolts into the plate as shown in figure 7
- C) Finger tighten the nuts on the ends of all the U-bolts.
- D) Locate the six collar insulators. Place each under a U- bolt.
- E) Using a 7/16" wrench tighten the U-bolts until the collars are just held in place.
- F) Take the assembled unit and slide it over the base of the antenna. They should slide freely. If not, they are overtightened and the U-bolts should be loosened.
- G) Continue to slide this unit up the base, until the collar on the first unit butts against the lower portion of the antenna. Tighten the nuts securely on the top unit.
- H) Make sure the nuts that hold the Lower section to the mount plate assembly are tight.
- I) Locate your 1 1/4" mast. Carefully slide your mast thru the 3 vacant insulating collars until your mast pipe is flush with the top of the mount plate assembly. Tighten all U-bolts with a 7/16" wrench.

#### 5.5 COAX TAIL

- A) Bring the coax tail out through the exit hole in the side of the Lower Section. Locate the PL259 connector with adapter. Attach the connector to the coax. See the ARRL Handbook if you are unsure of the procedure. In your final installation, make sure the connector does not touch your mast.
- B) If properly connected, an ohm meter will read "open" when placed from centerpin to shell.

**NOTE** If your pipe is slightly oversized slit the PVC collars to allow for expansion. Operating without these insulators can affect performance.

FIGURE 7



## 6.0 PRETEST PROCEDURE

It is always best to test the TITAN at ground level before elevating it. Pretesting is not difficult and may save time and effort in the total process. This is particularly true if the antenna is to be significantly elevated.

- A) Locate an open space.
- B) Obtain an 11/4" pipe 5' long.
- C) Attach this pipe to the TITAN see section 5.4.
- D) Obtain 3 lengths of rope 25-30' long.
- E) Attach ropes just above the GAP.
- F) Insert a screw driver or small diameter tube in the ground.
- G) With help raise the antenna until it is vertical.
- H) Place your 5' pipe over the screwdriver or tube, this will keep the base in place.
- I) Secure the temporary guy ropes
- J) Complete the hoop assembly see section 5.3. For this test it is not necessary to put screws into the Counterpoise rods.

## 6.1 GENERAL

A ham band transceiver and SWR meter are required for these tests. It is recommended that you use the minimum necessary power for the measurement. If possible, use an SWR bridge separate from that provided in your transceiver. Using a pencil, record your data in the space provided below.

## 6.2 FIRST OPERATION

A) If the TITAN has been assembled properly it will resonate close to the selected frequency on 75/80 meters. You should see a useable bandwidth in excess of 100 KHz under normal operation. Using minimal power, 10 watts or less;

Record the minimum VSWR on 75/80.

2:1 VSWR Hi frequency

2:1 VSWR Low frequency

B) Using minimal power, determine the resonate frequency on 40 meters.

Minimum VSWR

2:1 Hi frequency

2:1 Low frequency

C) 30 meters is next. Frequency: 10.100

10.125

10.150

D) 20 meters

14.00

14.175

14.350

E) 17 meters

18.068

18.118

18.168

F) 15 meters

21.00

21.225

21.450

G) 12 meters

24.890

24.990

H) 10 meters

28.00

28.50

29.00

1  
4000

3875

1.9

7299

7200

1.0

1.1

1.0

2.4

2.3

2.0

1.9

2.1

2.3

2.0

1.0

1.1

1.0

125.1

✓✓

3.0

1.1

✓✓

1.0

✓✓

1.1

✓✓

2.0

✓✓

1.0

✓✓

1.1

✓✓

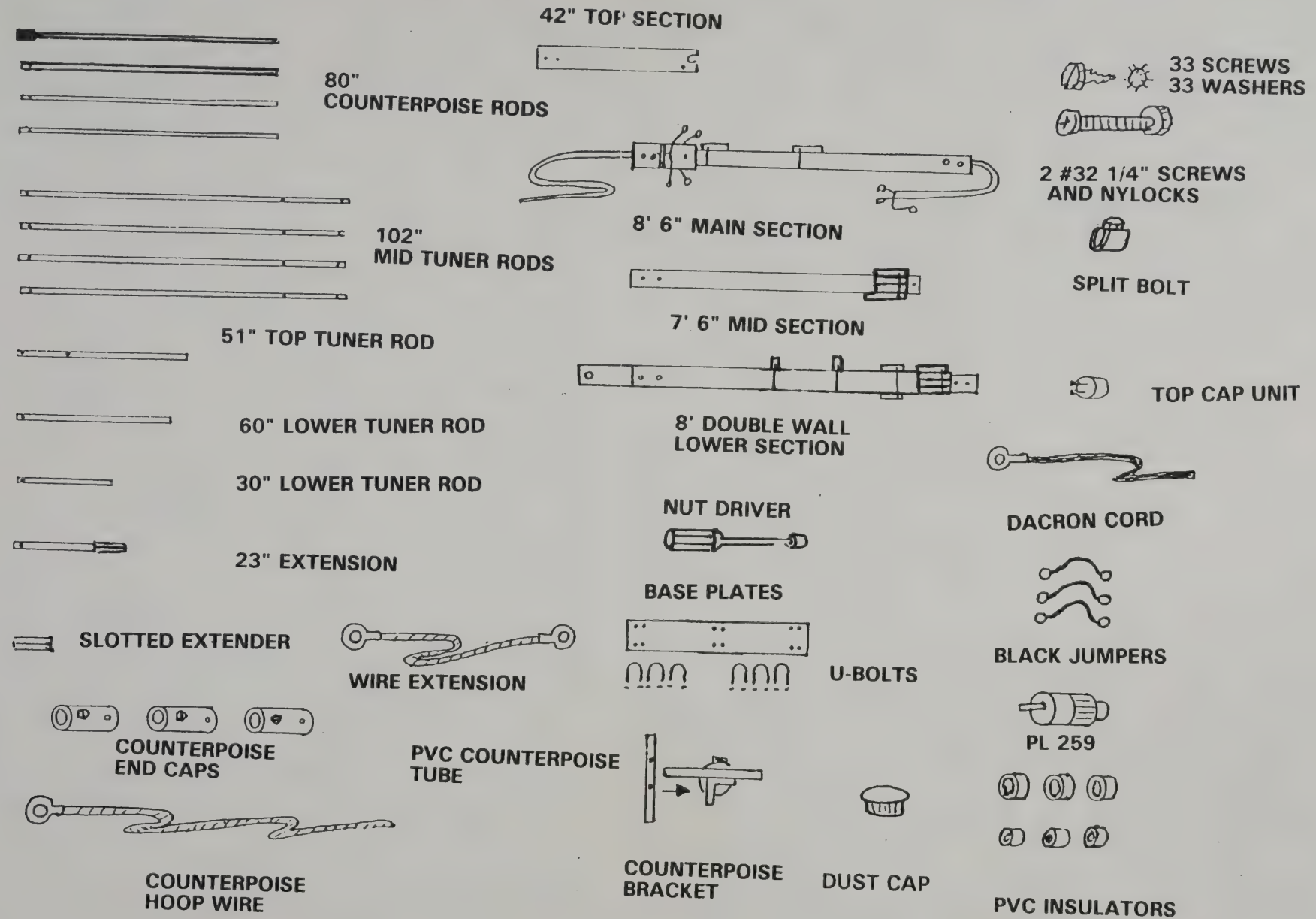
1.0

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# TITAN ANTENNA PARTS LIST

FIGURE 2



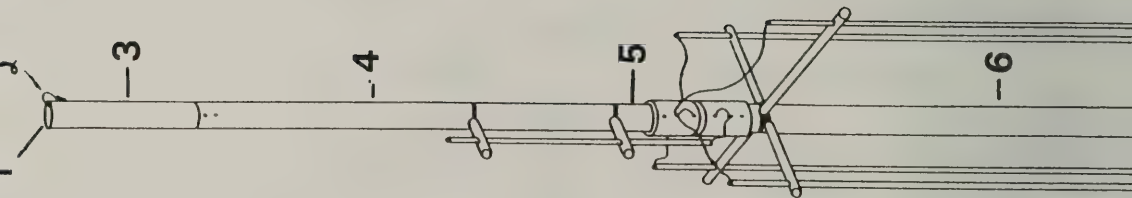


FIGURE 1

- 1 DUST COVER
- 2 TOP YELLOW LEAD
- 3 TOP SECTION
- 4 MAIN SECTION
- 5 GAP - CENTER INSULATOR
- 6 MID SECTION
- 7 TUNER ROD EXTENDERS
- 8 LOWER SECTION

44-10000-0000

**7.0 GENERAL**

The TITAN DX-VIII has been designed to operate on the 8 bands specified. Operation outside the specified bands may damage the antenna.

Use of an antenna tuner is not required nor recommended. Tuners will not improve the performance of the antenna, although they may permit a solid state transmitter to put out more power.

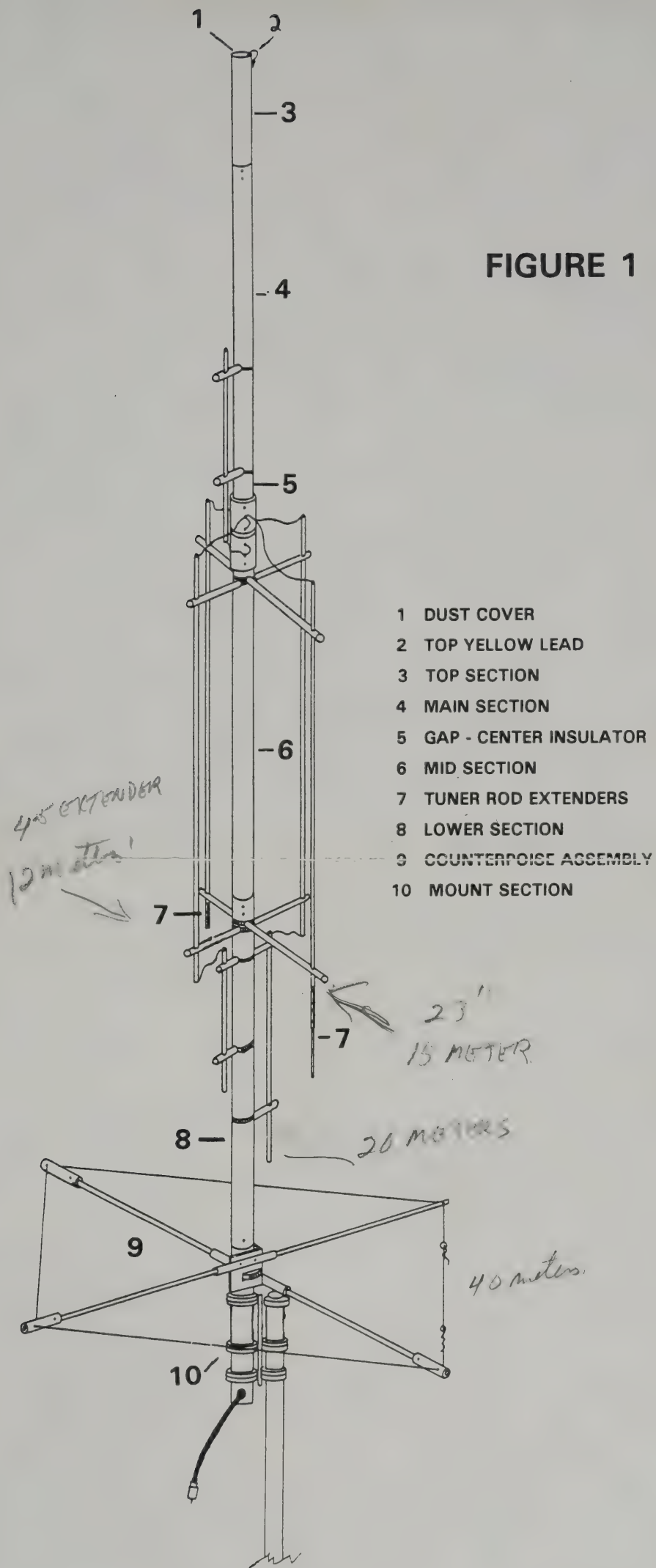
Operation of the antenna using a tuner on any frequency where the VSWR exceeds 2:1 may damage the antenna. Use when VSWR is less than 2:1 is acceptable.

**7.1 MALFUNCTION**

- A) If the antenna fails to resonate on the 75/80 meter band the CAP unit plugged on at the top of the antenna may not be making proper contact or was inadvertently shorted when the screw was inserted.
- B) If all your standing waves are high, double check the PL259 connector at the base of the antenna and make sure it is open from center pin to shield.
- C) If only a couple of bands are high eliminate the following possibilities;
  - 1) Bad coaxial feedline. If the coax has been in use for some time, it may be contaminated. Place a 50 ohm dummy load at the far end of your feedline, in place of the antenna. Any indication of varying VSWR or a standing wave greater than 1:1 suggest defective coax.
  - 2) Mutual coupling with nearby vertical metal objects may detune the TITAN. Check to see if any of the items suggested in section 1.2 & 1.3 apply.
  - 3) Transceivers with built in SWR bridges may not correctly indicate when their power reduction circuits take over. Retest with a separate VSWR meter.
  - 4) The transceiver or transmitter may be emitting a spurious signal in addition to the desired signal. Retest using the lowest possible power level. If possible try another rig.

If you are unable to solve the problem, contact the factory for assistance. Please have section 6.2 filled in and handy when you call. We do not charge for assistance and our phone number is (407) 778-3728.





**ASSEMBLED TITAN ANTENNA**

**7.0 GENERAL**

The TITAN DX-VIII has been designed to operate on the 8 bands specified. Operation outside the specified bands may damage the antenna.

Use of an antenna tuner is not required nor recommended. Tuners will not improve the performance of the antenna, although they may permit a solid state transmitter to put out more power.

Operation of the antenna using a tuner on any frequency where the VSWR exceeds 2:1 may damage the antenna. Use when VSWR is less than 2:1 is acceptable.

**7.1 MALFUNCTION**

A) If the antenna fails to resonate on the 75/80 meter band the CAP unit plugged on at the top of the antenna may not be making proper contact or was inadvertently shorted when the screw was inserted.

B) If all your standing waves are high, double check the PL259 connector at the base of the antenna and make sure it is open from center pin to shield.

C) If only a couple of bands are high eliminate the following possibilities;

1) Bad coaxial feedline. If the coax has been in use for some time, it may be contaminated. Place a 50 ohm dummy load at the far end of your feedline, in place of the antenna. Any indication of varying VSWR or a standing wave greater than 1:1 suggest defective coax.

2) Mutual coupling with nearby vertical metal objects may detune the TITAN. Check to see if any of the items suggested in section 1.2 & 1.3 apply.

3) Transceivers with built in SWR bridges may not correctly indicate when their power reduction circuits take over. Retest with a separate VSWR meter.

4) The transceiver or transmitter may be emitting a spurious signal in addition to the desired signal. Retest using the lowest possible power level. If possible try another rig.

If you are unable to solve the problem, contact the factory for assistance. Please have section 6.2 filled in and handy when you call. We do not charge for assistance and our phone number is (407) 778-3728.

## **WARRANTY**

GAP Antenna Products, Inc. provides a limited warranty on its products against any defects in material and workmanship for a period of 90 days after date of purchase/shipment. This warranty applies to the original purchaser only. Purchaser should return defective product freight prepaid. GAP reserves the right to repair or replace product, at its discretion. Repaired or replaced product will be shipped freight prepaid within 30 days of customer return. This warranty is provided in lieu of any other warranty expressed or implied. The warranty is void if the product is subject to misuse, improper installation, accident, neglect, modification, repairs, or act of God.

GAP Antenna Products, Inc. shall assume no liability for incidental or consequential damages resulting from the purchaser's ownership of its products.

## **REPLACEMENT PARTS**

Replacement parts are available for any portion of the antenna. Contact factory for details.

## **DESIGN BASELINE**

GAP Antenna reserves the right to incorporate improvements and changes in the design without an obligation to update previously manufactured units.





ELL. Vertical 1774N

Called Chris at Sep 407-778-3728

To change resonant frequencies.

40 meters lengthen counterpoise  
up to couple of feet. to lower  
Resonant frequency  
Tighten Vaps to under the correct  
expect. to raise resonant frequency

15 meters using 23" extender  
Shorter or lengthen in  $\frac{1}{2}$  to 1"  
Improvements. Increase resonant freq.  
Shorter EXT.  
Decrease resonant freq.  
Increase EXT.

12 meters go up or down with  
Short extender. 10000 can be  
14000 is higher

20 meters. diff will now be  
placed in bottom to lengthen  
a lower frequency. 1.0  
good all r-na. Resonant close to 14000 1.0 14000 1.2



GAP VERTICAL TEST, 8/19/97  
 FOR SWR Bandwidth  
 Phone only 21MH. 21300 TO 21450  
 Resonant freq. 21225  
 2.1

24893	24990
1.6	2.0

18068	18867
1.4	1.1

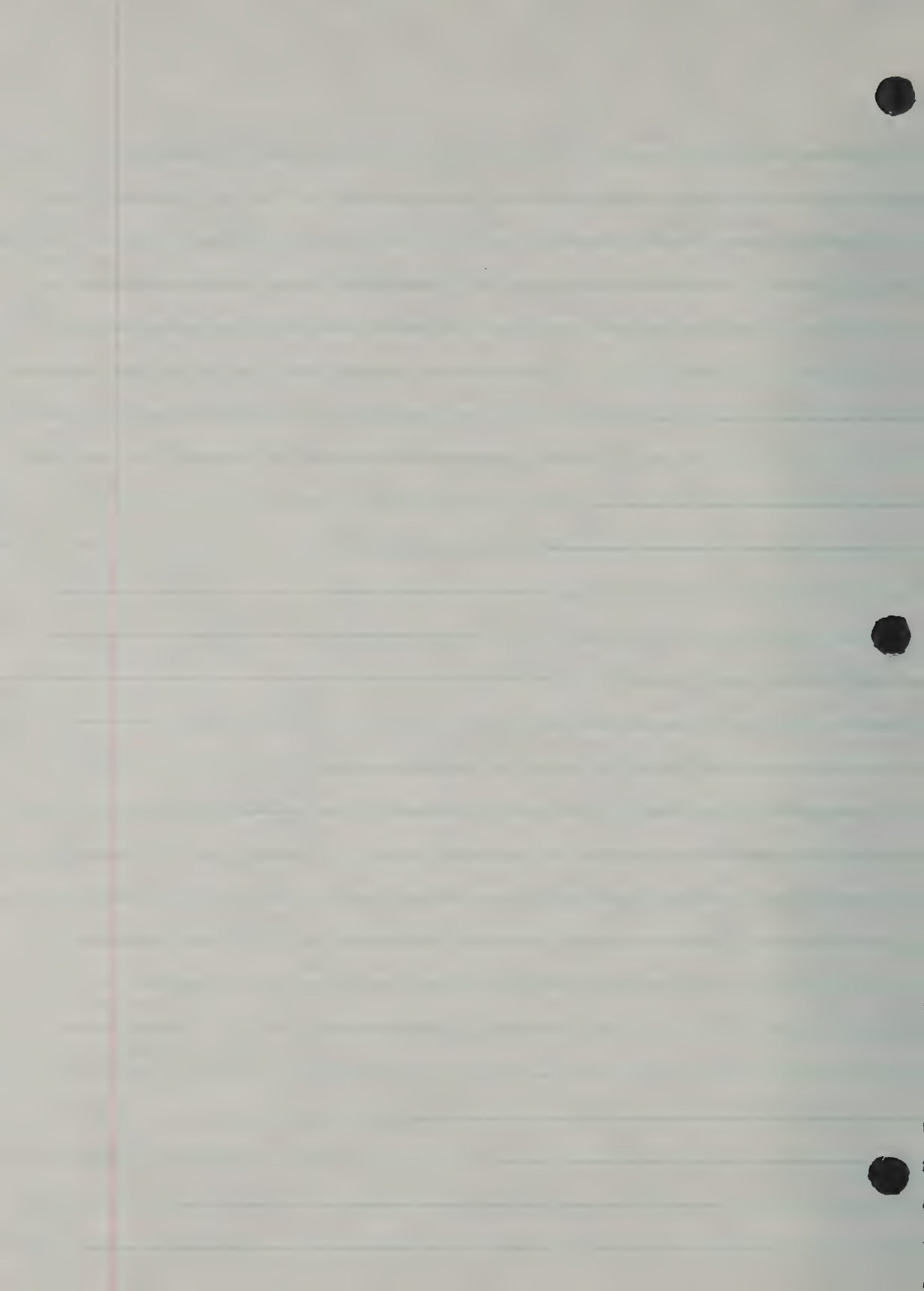
14026	14350
1.5	1.1

USE 450 S ONLY	10100	10150
MAX POWER ALLOWED	2.1	2.1
IS 200W.		

7029		7240
7025	7162	<del>7302</del>
2.1	1.1	2.1

3910	4000
1.9	1.2





**6.1 GENERAL**

A ham band transceiver and SWR meter are required for these tests. It is recommended that you use the minimum necessary power for the measurement. If possible, use an SWR bridge separate from that provided in your transceiver. Using a pencil, record your data in the space provided below.

**6.2 FIRST OPERATION**

A) If the TITAN has been assembled properly it will resonate close to the selected frequency on 75/80 meters. You should see a useable bandwidth in excess of 100 KHz under normal operation. Using minimal power, 10 watts or less;

Record the minimum VSWR on 75/80.

	<u>3995</u>	<u>1.0</u>
2:1 VSWR Hi frequency	<u>4000</u>	<u>1.1</u>
2:1 VSWR Low frequency	<u>3860</u>	<u>3.2</u>

B) Using minimal power, determine the resonate frequency on 40 meters.

Minimum VSWR 7100 1.2

2:1 Hi frequency 7190 1.8

2:1 Low frequency 7000 1.7

C) 30 meters is next. Frequency: 10.100

10.125

10.150 :

<u>2.1</u>	<u>1.4</u>
<u>2.1</u>	<u>1.4</u>
<u>2.1</u>	<u>1.4</u>

D) 20 meters

14.00

14.175

14.350

<u>1.45</u>	
<u>1.0</u>	
<u>1.0</u>	

E) 17 meters

18.068

18.118

18.168

<u>1.0/1</u>	
<u>1.0</u>	
<u>1.0</u>	

F) 15 meters

21.00

21.225

21.450

<u>1.6</u>	
<u>1.2</u>	
<u>2.0</u>	

G) 12 meters

24.890

24.990

<u>1.5</u>	
<u>1.7</u>	

H) 10 meters

28.00

28.50

29.00

<u>0</u>	
<u>0</u>	
<u>0</u>	





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2:1 VSWR Hi frequency

2:1 VSWR Low frequency

B) Using minimal power, determine the resonate frequency on 40 meters.

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2:1 Low frequency

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14.00

14.175

14.350

E) 17 meters

18.068

18.118

18.168

F) 15 meters

21.00

21.225

21.450

G) 12 meters

24.890

24.990

H) 10 meters

28.00

28.50

29.00



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24.990

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28.00

28.50

29.00





THE ANSWER IS GAP TECHNOLOGY • THE ANSWER IS GAP TECHNOLOGY

# REVOLUTIONARY ANTENNA TECHNOLOGY



Fellow Amateur—

**LET'S LOOK AT ANTENNA TECHNOLOGY REALISTICALLY.** For the last 50 years there have been no advances in vertical “technology” — a technology consisting of a vertical wire, fed at the base, surrounded by any number of radial wires. To operate multiband, traps had to be placed at appropriate points to shorten the antenna to a 1/4 wave on various bands. Manufacturers extolled their antennas based on “low loss” trap design, implying their antenna would out-perform the others. Yet big signals on the band did not come from these verticals. DX contacts, with the vertical’s well known low angle radiation, did not happen consistently. The vertical became a 2nd class citizen used by those with little space, minimal finances or a need to comply with local restrictions.

If a new amateur asked what antenna to put up, the common response from another ham was, “put up a dipole”. Why? Because a conventional vertical is *the most inefficient, noisy antenna available for amateur use and the trap version is even worse.*

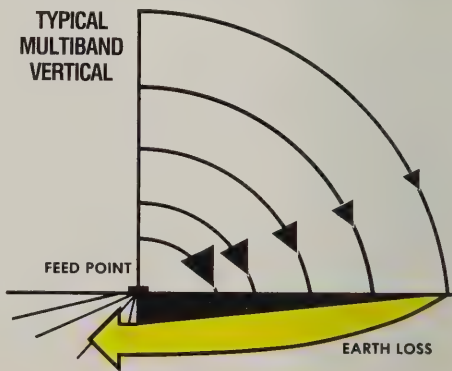
## WHERE DOES THE POWER GO?

For example, the 26 foot vertical on 80 meters should be 66 feet high. The “missing” 40 feet is replaced by coils (traps). This short antenna has a radiation resistance of 4 ohms. It’s a “virtual” resistor, which when power is applied, radiates R.F. That, however, isn’t the only resistor in the antenna system. There are more. The significant resistor is called **earth loss**, which is a function of the radials and ground. If three radials are used, the earth loss created is more than 30 ohms. We now have an antenna with 4 ohms that radiate and 30 ohms that warm the ground for a total of 34. *But only 4 ohms radiate!* If 100 watts powers this antenna, only 12 watts actually radiates. If you add lossey traps equaling 2 ohms, the power out drops from 12 watts out to 11 watts out. While traps have their own deficiencies, *it is the huge earth loss that really matters.* Fortunately, GAP technology conquers this problem.

## RADIALS ARE NOT THE ANSWER

I know, you’ve heard “put out a lot of radials”. If you found 4000 feet of wire for 60 radials and the room to bury them, the earth loss will drop from 30 to 4 ohms. All that effort and the radiated power is now only 50 watts. *Half is still warming the ground!* Worse than that, you now destroy the multiband operation. A multiband vertical must have earth loss to work! That’s why a multiband vertical mounted on your roof won’t work all the bands.

It was obvious that a new vertical design was needed. **The design objectives:** increase the radiation resistance and decrease or eliminate the earth loss.







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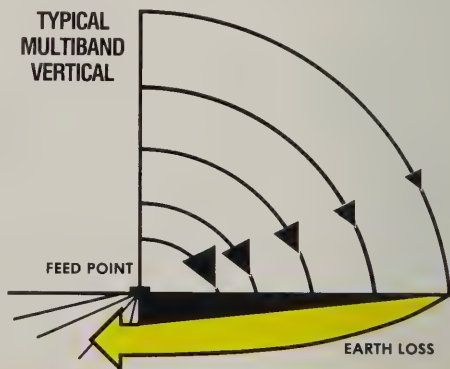
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**6.2 FIRST OPERATION**

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Record the minimum VSWR on 75/80.

2:1 VSWR Hi frequency

2:1 VSWR Low frequency

B) Using minimal power, determine the resonate frequency on 40 meters.  
Minimum VSWR

2:1 Hi frequency

2:1 Low frequency

C) 30 meters is next. Frequency: 10.100

10.125

10.150 :

D) 20 meters

14.00

14.175

14.350

E) 17 meters

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28.00

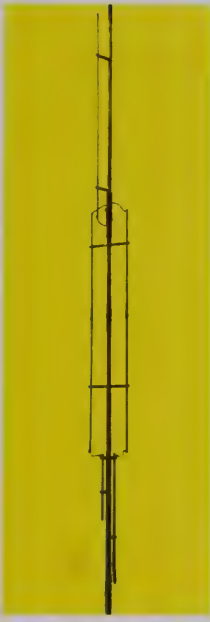
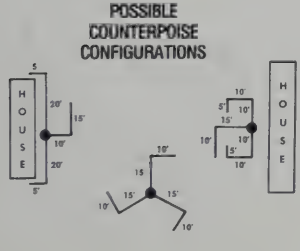
28.50

29.00



# THE CHALLENGER DX

The Challenger antenna is the first production multiband antenna to utilize GAP technology. Thousands of Challengers are now in use throughout the world. From the jungles of New Guinea to the bitter cold of Finland to the brutal sands of Desert Storm, Challenger with its elevated feed links its user with the rest of the world. Challenger is the first and only antenna capable of operating on eight separate bands from 3.5 MHz to 144 MHz. Its operating bands are 80m, 40m, 20m, 15m, 12m, 10m, 6m and 2m. Over 130 KHz of bandwidth is provided on 80m. On 2m Challenger is a great base station antenna. CQ tested the Challenger and established that on 2m, for example, its gain was approximately 6 to 8dB. On 40m compared to a monoband vertical, they found Challenger an S unit stronger. This is typical of the many reports received from amateurs around the world. Challenger is designed to be mounted directly in the ground or elevated. A ground mount is provided with each antenna. With the ground mount in place, the Challenger simply drops in. If necessary, because of space limitations, but not to improve performance, Challenger may be roof mounted since it does not require earth loss to obtain a 50 ohm match. Challenger requires a counterpoise of three 25 ft insulated wires. They may be buried or just scattered on the ground. Symmetrical deployment is not critical. Adding additional wire will not significantly improve performance. All of these are covered in a 16-page assembly manual provided with each antenna.



**CHALLENGER DX**  
8 Band Multiband DX Antenna

**SPECIFICATIONS**

**Bands**  
80m 40m 20m 15m 12m 10m 6m 2m

**Bandwidth**—Under 2:1  
Entire band on 40m 20m 15m 12m 6m 2m  
80m over 130 KHz; 10m over 1 MHz

**Height**  
31.5 ft.

**Weight**  
18 lbs.

**Radiation Efficiency**  
Exceeds conventional verticals by up to 600%

**Mount**  
Ground or elevated  
A ground mount is supplied

**Counterpoise**  
3 at 25 ft.

**Ground Area Required**  
Fits in 10 ft. by 12 ft. area



## UNIQUE FEATURES STANDARD TO ALL GAP ANTENNAS

- Unique "Elevated" Feed
- No Tuning Required
- No Traps
- Automatic Band Switching
- No Tuner Required
- Input Power: Legal Limit\*
- Input Impedance: 52Ω Nominal

## FOUR REASONS TO AVOID TRAPS

- A trap is a coil-capacitor device that operates at high voltage. High voltage in a moist environment is prone to arc and destroys itself.
- The coil portion of the trap changes its value as a function of temperature shifting the operating frequency of the antenna.
- A trap must have a high Q to perform efficiently. A high Q trap will have a narrow bandwidth and restrict antenna bandwidth.
- Finally, as everyone knows, traps are lossy. They rob transmitter power.

The chart tabulates the VSWR and efficiency versus antenna height for a typical basefed 160m vertical

	IDEAL	FULL SIZE	HALF SIZE	26 FT. KIT
Radial	200	3	3	3
Antenna Resistance	36Ω	36Ω	7Ω	15Ω
Earth Loss	0Ω	29Ω	29Ω	29Ω
VSWR	1.44:1	1.25:1	1.20:1	1.7:1
ERP	100w	50w	19w	3.3w
Input Power	100w	100w	100w	100w
Radiated Power	100w	50w	19w	3w

Check the VSWR. In all cases it is acceptable **VSWR does not measure how efficient an antenna is!**



## HORIZONTAL OR VERTICAL?

Why is a dipole ineffective on the low bands for many amateurs? A dipole's performance is a direct function of its height, measured not in feet but in λ (wavelengths). A 10m dipole at 32 ft. is 1 λ high, but a 160m dipole at 32 ft. is only 0.06 λ high! To appreciate the degraded performance, lower the 10m dipole to 2 ft. off the ground. Now it is .06 λ high. Bottom line: dipoles on 160m are not very practical; vertical antennas are the obvious alternative, but rarely are they "big signals". Ordinary verticals have their own set of problems — excessive height requirements and vast ground areas for radials. A quarter wave on 160m is a 130 ft. high, on 80m it is 66 ft. On 160m, one needs almost an acre of ground just to accommodate the radials.

Using a vertical less than full height lowers the antenna's radiation resistance dramatically. This is the resistance that accounts for signal radiation.

# THE VOYAGER DX

This is the first antenna manufactured specifically to provide efficient low band operation from the typical backyard without a huge investment in time, money and space. The Voyager is not another "add a kit" antenna for 160m. The GAP Voyager DX-IV incorporates the identical *unique technology* as in the Challenger DX-VIII to "open up" the low bands. Emphasis was given to 160m and 80m when designing the Voyager, because of the difficulties these bands create and the lack of previous technology to overcome them.

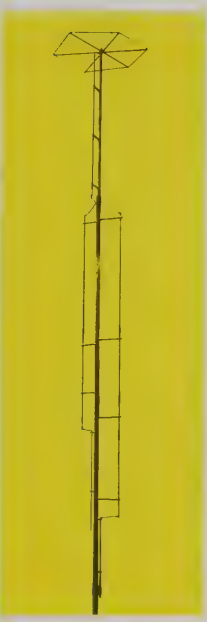
Unlike the Challenger, the Voyager employs a capacity hat with circular ring to reduce the physical height to 45 ft. while maintaining an electrical height of 66 ft. A capacity hat is the most efficient way to reduce height, maintain bandwidth and eliminate corona.

As an integral part of the design, GAP technology uses parallel tuner rods to perform a number of functions, one of which is on 40m. They create a vertical dipole for increased low angle gain. Unlike the trap multiband antenna, the Voyager utilizes the entire antenna on all bands. For those who detest the need to "alter" purchased antennas, no tuning or matching is required to put the Voyager on the air.

If you have always wanted to operate the low bands, go for DXCC on 80m or WAS on 160m, now with Voyager, you can. If you want to work CW on 3.55 and SSB at 3.95 or switch to 20m and work a JA, now you can—without a tuner.

## QUIET, PLEASE!

Noise is the unwanted companion of verticals — particularly on the low bands. The Voyager, like all GAP verticals, is a "quiet" antenna primarily due to a sleeved feedline and the use of a counterpoise. GAP Antennas eliminate the deployment of thousands of feet of radial wires "parallel to" the power lines which transfer power line noise.



**VOYAGER DX**  
4 Band Multiband DX Antenna

**SPECIFICATIONS**

**Bands**  
160m 80m 40m 20m

**Bandwidth**—Under 2:1  
Entire band on 80m 40m 20m;  
160m over 90 KHz

**Height**  
45 ft.

**Weight**  
30 lbs.

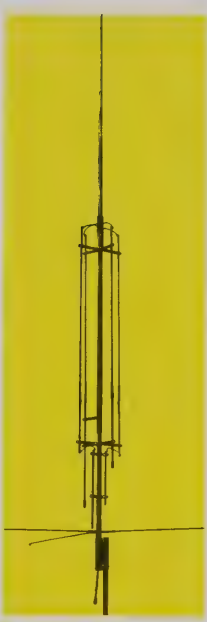
**Wind Load**  
7 sq. ft., requires two sets of guy ropes

**Mount**  
Ground  
Aluminum pivot and guy brackets supplied

**Counterpoise**  
3 at 57 ft.

**Deployment pattern** is very flexible.

**Ground Area Required**  
4 guy anchor points 25 ft. from base mount



**EAGLE DX**  
6 Band Multiband DX Antenna

**SPECIFICATIONS**

**Bands**  
40m 20m 17m 15m 12m 10m

**Bandwidth**—Under 2:1  
Entire band on 40m 20m 17m 15m 12m; 10m over 500 KHz

**Height**  
21 ft.

**Weight**  
11 lbs.

**Mount**  
Virtually anywhere  
Supplied pole mount fits your 1.25 in. antenna mast

**Counterpoise**  
3 rigid counterpoises  
80" long

**Ground Area Required**  
None

\*300 watts on 40m - Eagle only

# THE EAGLE DX

The Eagle is the smallest antenna in the GAP product line. Its development was the result of your requests for a low profile, high efficiency GAP antenna. The Eagle DX-VI weighs just 11 pounds and can be installed almost anywhere—at ground level, on a pole, on your roof or atop a tower. It is essentially a set of vertical dipoles—the optimum singular DX antenna. No traps, coils or transformers are used to achieve multiband operation in this antenna either. Why is that significant? Traps are the "weak link in the chain" of a multiband antenna.

Critical to the design of the GAP Eagle was the requirement to permit operation anywhere on all of its designed frequencies. The Eagle provides full coverage with a VSWR less than 2:1 on 40m, 20m, 17m, 15m and 12m and approximately 500 KHz on 10m without readjusting. 10m operation is further optimized with a supplied extender. Compare that performance to any other low profile vertical. With the Eagle, as with all GAP antennas, you will not need to buy a tuner. If a rare DX station appears on 7.050, but, you normally work the SSB nets around 7.250, just slide the VFO and key the rig!

If the band is wide open, you might work a LU6 with a coat hanger, but when conditions are less than perfect you want the highest S meter reading an antenna can provide. *Efficiency is critical.* The efficiency of the GAP Eagle is without equal. It has no traps, transformers or matching coils to rob transmitted or received power. For the highest S meter, choose a GAP Eagle.

## TUNING

Tuning can be a nasty task particularly if you mounted the antenna on your roof. In fact, it can become dangerous as trip after trip to readjust the antenna raises your frustration level and you lose your "cool". A GAP Eagle, like all GAP antennas, comes completely electronically pretuned from the factory. *There is absolutely nothing for you to tune.*

If you're looking for a reliable, efficient, broad band low profile antenna that will serve you well and dig out the DX, the GAP Eagle is for you.



## THE ELEVATED GAP

GAP antennas launch RF at an "elevated" point. Elevating the feed point raises antenna resistance, diminishes earth loss and therefore improves efficiency significantly. The feed point is placed high, generally above the height of most verticals. An insulated gap is placed in the mast at this point which allows the RF to flow out on the antenna. Propagating RF in this manner obsoletes the trap design and the need for matching networks.

The elevated feed also eliminates the requirement to have maximum current at ground level where you can't fully utilize it. Maximum current can now be moved up the mast. Raising the current point improves the DX angle—and increases low angle gain. A GAP antenna does not employ traps, coils, transformers, baluns or resistors. No GAP antenna requires earth loss to achieve a match.



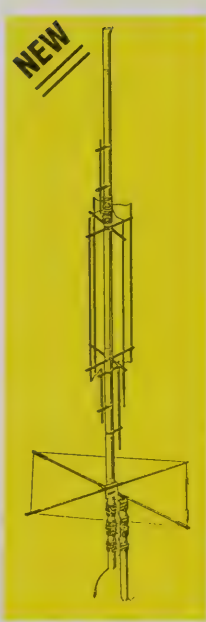
## RELIABILITY

All weather performance should be important to you. Simplicity and a minimal parts count are the key elements to reliability. Consider the elements of the GAP antenna—aluminum tubes and coax.

Nothing else! Compare that to other antennas with a multitude of connections, coils, variable capacitors, transformers, etc. and you'll see that for everyday operation in rain, sun, ice or snow—GAP works. Like any antenna, GAP antennas are not immune to lightning, however. Disconnect and shut down when it's around!

## GAP ANTENNAS ARE BUILT TO LAST

- All GAP antennas use double-drawn 6063-T832 aluminum tubing. Each section telescopes perfectly into the adjacent and is secured with screws. GAP does not use less expensive extruded tubing and "slit" the tubes to telescope and then secure with hose clamps.
- Hardware is stainless steel.
- The coax used is a special non-contaminating high temperature type to provide added safety for high power operation.



**TITAN DX**  
8 Band Multiband DX Antenna

**SPECIFICATIONS**

**Bands**  
10m 12m 15m 17m 20m 30m 40m and 100 KHz on 80m

**Bandwidth** - under 2:1  
Entire band on 40m, 30m, 20m, 17m, 15m, 12m, 10m 100KHz on 80m

**Height**  
25 ft

**Weight**  
25 lbs

**Mount**  
All hardware supplied except the 1 1/4" steel pipe

**Counterpoise**  
4 rigid counterpoises  
80" long

**Ground Area Required**  
None

# THE TITAN DX

Your latest requests have been for an antenna that's easy to setup, needs no radials, covers 10m-80m in addition to all the WARC bands and uses the same GAP technology found in our other products. In response to these requests GAP is proud to announce the newest addition to the family, the Titan.

The Titan is a center fed GAP vertical, that provides a host of benefits in a rugged, yet manageable form. The Titan offers broad, continuous frequency coverage in a no tune, easy to assemble format. Designed to work in a limited space or as the perfect compliment to an antenna farm.

One of the primary virtues of the Titan is the GAP center feed. By elevating the feed the earth loss is dramatically decreased, which means the RF is going out to make the contact instead of into the ground to warm the earth. Reducing the earth loss eliminates the need for a radial system. The Titan requires **NO RADIALS.**

Another key benefit the Titan provides is the ability to go virtually anywhere in the HF amateur spectrum, at anytime without having to make any adjustments. The Titan is the ONLY antenna marketed with total continuous coverage under 2:1 on 10m, 12m, 15m, 17m, 20m, 30m, and 40m and 100 kHz on 80m. Titan's broad bandwidth and no tune feature make it an ideal antenna for getting those multipliers during contests or switching frequencies as band conditions change.

The Titan is a respectable 25' tall and weighs a solid 25 pounds. The Titan is configured to mount easily on a 1 1/4" pipe. This pipe can be a length of your choosing and since the feedpoint is elevated this pipe can be as short as a foot.

The first 8' of the antenna is comprised of double wall tubing and where the Titan mounts to the mast the antenna is triple wall! Which means guys are not a necessity.

**All GAP antennas are designed and manufactured in the U.S.A.**

To order, call (407) 778-3728



**6.1 GENERAL**

A ham band transceiver and SWR meter are required for these tests. It is recommended that you use the minimum necessary power for the measurement. If possible, use an SWR bridge separate from that provided in your transceiver. Using a pencil, record your data in the space provided below.

**6.2 FIRST OPERATION**

A) If the TITAN has been assembled properly it will resonate close to the selected frequency on 75/80 meters. You should see a useable bandwidth in excess of 100 KHz under normal operation. Using minimal power, 10 watts or less;

Record the minimum VSWR on 75/80.

2:1 VSWR Hi frequency

2:1 VSWR Low frequency

B) Using minimal power, determine the resonate frequency on 40 meters.

Minimum VSWR

2:1 Hi frequency

2:1 Low frequency

C) 30 meters is next. Frequency: 10.100

10.125

10.150

D) 20 meters

14.00

14.175

14.350

E) 17 meters

18.068

18.118

18.168

F) 15 meters

21.00

21.225

21.450

G) 12 meters

24.890

24.990

H) 10 meters

28.00

28.50

29.00



































## EQUIPMENT LITERATURE INDEX

1	MFJ-949E Versa Tuner II		
2	MFJ-202B Antenna Noise Bridge		
3	MFJ-784B Tunable DSP Filter		
4	MFJ-704 Low Pass Filter		
5	MicroCraft Cscan Code Scanner		
6	VECTRONICS HFT-100 Antenna Tuner		
7	YAESU FT-11R/HP 2M Transceiver		
8	ARRL World Grid Locator Atlas		
9	AMERITRON AL-811 Amplifier		
10	Gap Titan Vertical HF Antenna		
11	Barker & Williamson CS-5C Coaxial Switch & 424 Low Pass Filter		
12	AMERITRON AL-811 Amplifier		
13	VAN GORDEN ENGINEERING All-Bander HF Dipole Antenna		
14	KENWOOD TS-430 Transceiver		
15	KENWOOD TS-450 Transceiver		











